NEW INSIDE - COMPUTING TODAY

APRIL 1981
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eti ELECTRONICS TODAY INTERNATIONAL

NEGATIVE ION GENERATORS -fact & fiction

10th BIRTHDAY ISSUE

AIR IONISER TO BUILD!

Video war hots up!

Kenwood FM tuner reviewed

SATURN - the strange planet

DICK SMITH CATALOGUE INSIDE

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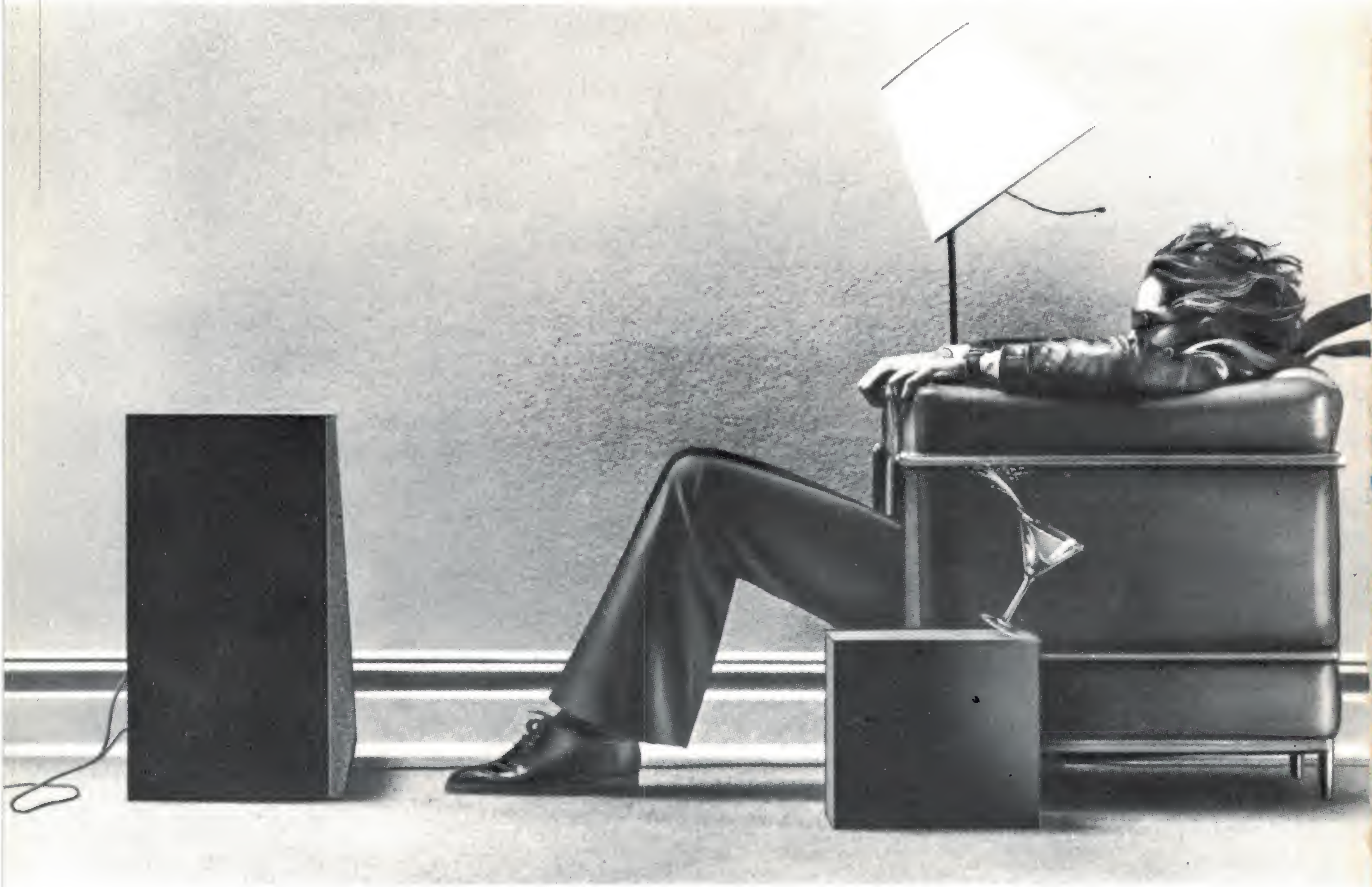

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ELECTRONICS TODAY INTERNATIONAL

QUICK INDEX

FEATURES:

TEN YEARS have now gone by since the first issue of this magazine. In these ten years we have seen electronics making an impact on society so profound that, in the words of the USA's National Academy of Science, "it could be even greater than that of the original industrial revolution".

Our still developing technology has already spread into a staggering range of products and processes. Mini and microcomputers are to be found in newspapers, supermarkets, banks, offices — and every conceivable manufacturing industry. Microprocessors smaller than a finger-nail control ignition and carburetion in cars, others control washing and sewing machines, typewriters, pin-ball machines — they are even finding their way into children's toys.

In many such applications the usage of this technology has brought obvious benefits: improvements in reliability and energy utilisation, reductions in pollution and costs, and in many instances the creation of safer working environments.

But it is foolish to pretend that all is for the best in this best of all (technological) worlds. Consider the following . . .

In the USA, the NCR company noted (in its 1975 annual report) that changing from making mechanical to electronic cash registers saved 75% labour content. That company slashed its labour force from 37 000 in 1970 to 18 000 in 1975. In Sweden, Ericsson Telecommunications reduced its labour force from 15 000 to 10 000 between 1975 and 1978.

In Britain, employment in the telecommunications industry dropped from 88 000 to 65 000 in the same three years. Here in Australia it has been estimated that 40% of our present unemployment has structural causes, and of that 40% about ten per cent is due to the impact of technology.

And that's *within* the electronics industry.

Outside the situation looks much worse . . .

In the Swiss watch-making industry alone 46 000 workers lost their jobs and seventeen manufacturers went bankrupt in the years immediately following the introduction of digital watches.

The French Government report 'L'Informatisation de la Societe' (Paris, La Documentation Francaise, 1978) warned that 30% of all jobs in the (French) banking and insurance industries could disappear before 1988. An (unpublished) report by Germany's Siemens Corporation suggested that 40% of all office jobs could be automated.

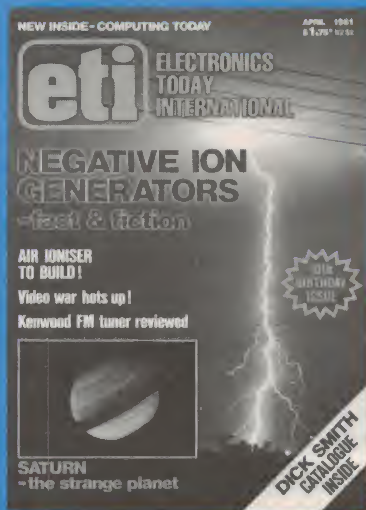
Several issues of this magazine could be filled with evidence such as that above. It is surely time for socially responsible engineers and technicians to at least question the continuing hyperbole from only too many of our industries' leaders about the impact of microelectronics on employment, and in particular the repeated claims that the technology creates jobs. Where is the evidence for these claims?

Collyn Rivers

Collyn Rivers
Managing Editor

advertisers

ELECTRONICS TODAY INTERNATIONAL

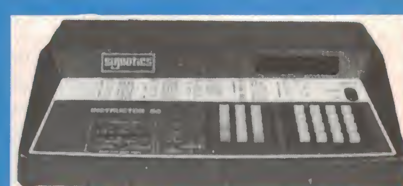


COVER

Lightning is a spectacular source of atmospheric negative ions . . and ozone! (Picture courtesy Bay Picture Library). Inset is an image of Saturn taken by Voyager I on 18 October 1980, with colour enhancement to increase the visibility of bright features. Cover design by Ivy Hansen.

*Recommended retail price only.

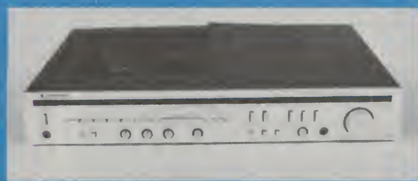
features



news

projects

sight & sound



general

SPECIAL OFFER
24W
SOLAR PANELS!
P.81

next month

IS THIS THE FACE OF JESUS CHRIST?
An ancient piece of linen cloth, 4.3 m long by 1.1 m wide, has the faint image of a naked man impressed upon it, bearing the unmistakable marks of crucifixion as described in the Bible. The Holy Shroud of Turin, as it is called, has attracted scientific interest like few other religious relics or archaeological artefacts. Some claim it the work of a mediaeval forger but a US forensic pathologist is convinced of its authenticity. Two US Air Force Academy professors have shown the image to have three-dimensional information — and have made a model. A team of 50 scientists and technicians examined the Shroud in October 1978. Results of this research are just appearing. Brian Dance reports on the startling evidence.

VIDEO DISC — AROUND THE CORNER?
What is it, what's inside the machines, where is it all going to end? Your questions answered. A fascinating rundown on this new consumer technology that is only just around the corner.

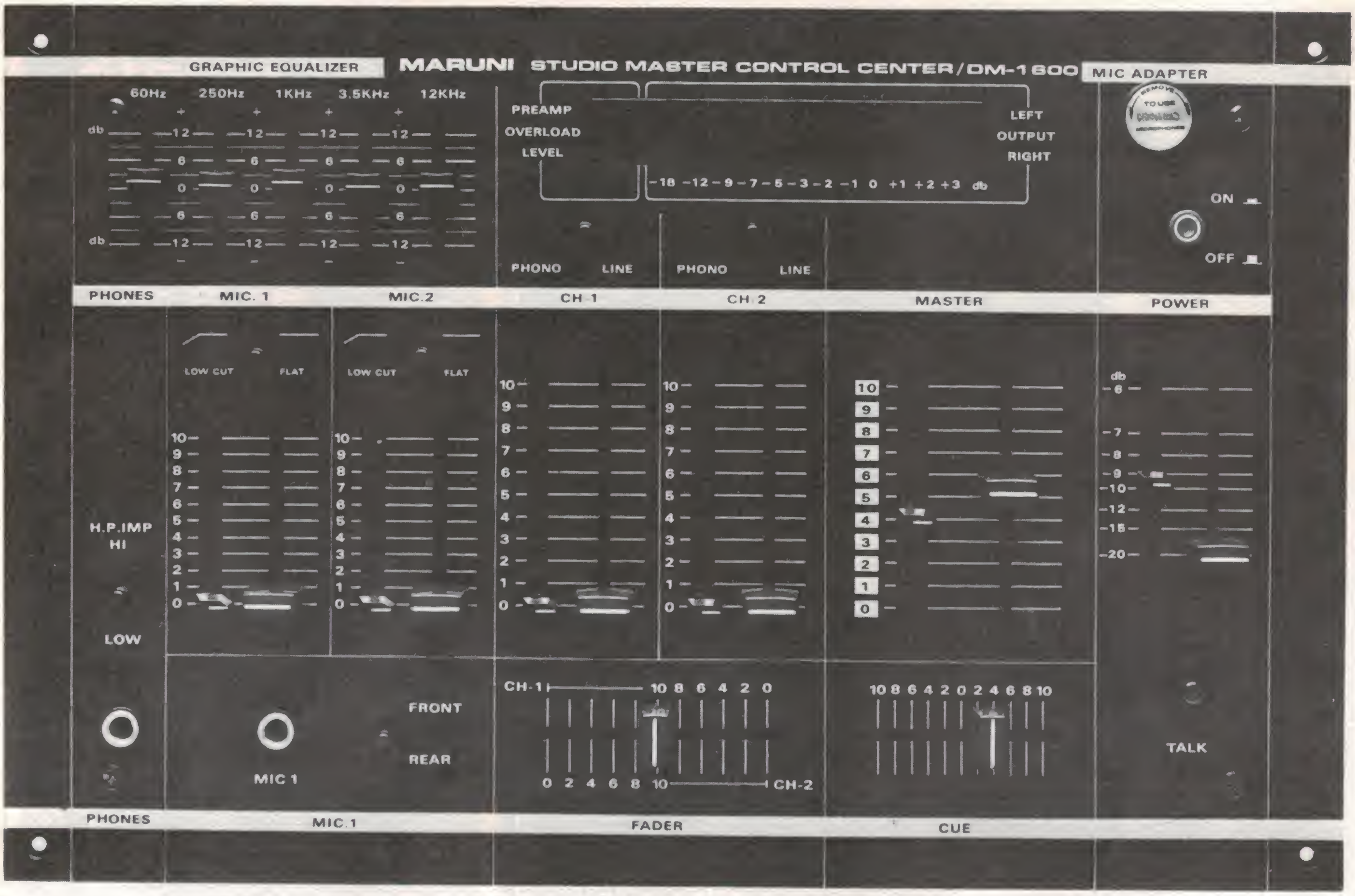
UHF TV CONVERTER
For those who don't have a television set with a UHF tuner and would like to watch those beautiful pictures appearing 'upstairs'. It's simple to build, simple to operate and inexpensive. Now, stop 'phoning us to request such a project!

WORDSQUARE GAME FOR THE TRS80
At last, some software for fans of Tandy's popular TRS80 microcomputer. Here's a simple fun game for owners of Level II machines. System 80 owners take note, too.

SONY'S TA-F80 AMPLIFIER
A review of an interesting piece of technology. Louis Challis found the TA-F80 had a good power-to-weight ratio (now *there's* a new amplifier parameter), excellent sound and top performance. But how did Sony do it?

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

Disco Centre DM1600 Studio Master Control



Broadcast quality mixer with integrated 5 channel graphic equalizer. 4 stereo program and 2 microphone inputs. T.H.D. only 0.06% at rated output of 1 volt. Built-in low noise pre-amplifier for magnetic phonos and low impedance microphones. Professional stereo slide controls. Headphone circuit to monitor each input. Variable talk switch to attenuate music volume from –6 to –20dB so microphones can be used without re-adjusting music levels. LED peak level and output indicators. Power switch relay protector. The DM1600 can be used with any amplifier with tape monitor facility.

SPECIFICATIONS (MIXER)

	Input Sensitivity	Input Imped.	Max. Input Level	Output Imped.	T.H.D. at 1 V	Hum & Noise	Frequency Response
Mike	1.5mV	10KΩ	100mV	600Ω	0.06%	–52dB	30-16000Hz (–1dB)
Phono	1.5mV	50KΩ	140mV	600Ω	0.06%	–62dB	30-20000Hz (RIAA ± 2dB)
Line	75mV	50KΩ	5V	600Ω	0.06%	–62dB	20-30000Hz (–1dB)

EQUALIZER

Control Frequencies	:	60Hz, 250Hz, 1KHz, 3.5KHz, 12KHz
Control Range	:	±12dB boost or cut
Control Type	:	Slide centre detent for flat setting
Headphone Output	:	(Q) 50mV at 75 Ohm at less than 0.5% T.H.D.
Talk Switch	:	Variable –6 to –20dB at Phono or Line at Talk position
Dimensions	:	W 39cm x D 26cm x H 9.5cm
Weight	:	5kg

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Ten years, 120 issues, six libel suits, around 600 projects . . . and not a single partridge in a pear tree!

Electronics Today was conceived by a 15-year-old schoolboy!

It all started back in 1968 when Kim Ryrie tried to convince his publisher father, Colin, that there was a market for an alternative to the long-established Electronics Australia.

Colin Ryrie considered the proposal and in January 1970 started advertising for an editor — in Electronics Australia! He sought an 'electronics journalist' with sound practical experience. Now these are about as scarce as EF91s in pocket calculators, so it was not altogether surprising that the advertisement appeared more than once.

Around the middle of 1970, Collyn Rivers, tired of his job of making digital equipment out of cardboard (true — but still defamatory to print the reasons why), rang Colin Ryrie to find out what the job was all about. A couple of months later he found himself designing a brand new magazine.

The new magazine was to have been called Modern Electronics — but to the company's disgust that title was used by another publisher before our magazine was due out. In retrospect they did us a favour — 'modern' is an outmoded word.

ETI's founder and now Managing Editor, Collyn Rivers.

So Electronics Today was born on March 23rd 1971.

There was originally a staff of two. Collyn did all the writing and putting together; Barry Wilkinson (also ex the cardboard electronics factory) designed all the projects and prepared all the drawings.

Barry and Collyn worked like that for three years — a 12-hour day was an ambition then; Barry even worked right through Christmas Day, Boxing Day and New Year's Day in two of those years.

Eventually it all began to work (i.e: stop losing money) and more staff were taken on. Nevertheless, even today ETI is produced by fewer staff than you'd ever believe (and they wonder sometimes . . .).

Collyn is now the group's research and planning manager as well as ETI's managing editor.

Roger Harrison took over as editor two years ago. As Collyn says, he was the first prospective editor to tell Collyn that "he could do it better". To Roger's surprise that was exactly what Collyn was seeking! (Guess who's now working those sixteen-hour days?)

Twelve months after Electronics Today came into being we started the magazine in Britain — initially using 95% Australian material. Nowadays it's the UK's most successful electronics publication, with sales nearly twice that of Wireless World.

Current editor Roger Harrison, with thinking cap!

Six months later came a French language edition, Electronique pour Vous. This was successful — but not for us. We sold out to the French publishers a few years later.

In 1977 we started Canadian, Dutch, and German language editions. All are an ongoing success.

Our overseas editions are the reason why Electronics Today became Electronics Today International, a change in title which we now regret, because the great Oz syndrome of 'good stuff only comes from overseas' causes only too many readers and potential readers to believe we're an Australian subsidiary of an overseas publisher! We're not, fellas — ETI's a hundred per cent dinkum.

A complete edition of this magazine could be filled with stories behind the scenes . . . one of the strangest happened in June/July 1971.

Our then Prime Minister had made a series of quite specific statements to the effect that the OMEGA system was simply a civil navigational aid. These statements were and are demonstrably untrue. Full details of OMEGA's role as the navigational aid for US submarines were openly available outside this country. So we ran a major feature explaining how, what, when, where, and why, illustrated by untouched photographs obtained from the **US Navy itself.**

Steve Braidwood, editor, May 76 - May 77.

Les Bell, editor, June 77 - March 79.

This resulted in a day-long visit from the CIA — demanding amongst other things to be given the name and address of our main contributor. The fact that this was printed in 12 point bold type on the very first page of the article had completely escaped them! When they finally caught up with our contributor — a respected academic in New Zealand — he had pleasure in presenting them with his files of source material — all press releases from the US Navy!

Ho hum.

Some of the fiercest battles have been fought with suppliers of review equipment.

Essentially we report what we find, good or bad. This not entirely universal publishing trait doesn't go down too well with some suppliers (others love it), but as a good review is worth a very great deal in subsequent sales they take the risk.

The following story is true.

Some years ago we reviewed a pair of speakers which we'll call 'Tempests'. They were **dreadful**. And we mean **dreadful**. Our reviewers' measurements showed a hole in the mid-range about 20 dB deep and nearly an octave wide. On many records some instruments could quite literally not be heard. They simple dropped off the record.

So we obtained a second pair — which proved exactly the same.

We duly published what we'd found; the importer cancelled $25 000 worth of advertising and continued to praise his product elsewhere.

For some considerable time after, 'Tempest' speaker sales staff abused us and our reviewers, maintaining that their product was beyond criticism, and indeed they had innumerable overseas reviews praising the product to the sky.

Then, some two and a half years later, the American magazine Absolute Sound reviewed the same product. They said much the same as we'd done — and published very similar response curves.

The 'Tempest' factory dug out our review — compared the two — and took immediate action. Sure enough, they'd produced a batch of spectacularly crook speakers — some of which found their way here, some to the USA.

But for two years we'd been asked to withdraw our review and threatened with legal action if we didn't. Another publication praised the self-same units. And innumerable sales staff continued to believe brochures, not their ears.

There's a moral there somewhere.

Then there was that memorable day when we received letters from four separate solicitors, each claiming that his client and his alone had the sole right to advertise a certain product and each threatening legal action if we didn't publish his letter.

So we did — all four on the same page.

Why was the December 1980 issue late on sale? We were forced at the very last minute to scrap 45 000 already printed 32-page sections due to a legal dispute between two major advertisers over who owned the right to sell what!

Our fifth birthday was amusing. We'd made a slight reference to it the month before and our distinguished, older, and generally wiser competitor assumed that we'd make a big splash about it on our next month's cover.

We didn't. They did, leaving a substantial number of bemused readers wondering what was so special about being 39 years old!

So, on to the next ten years. It's hard work, but **never** dull!

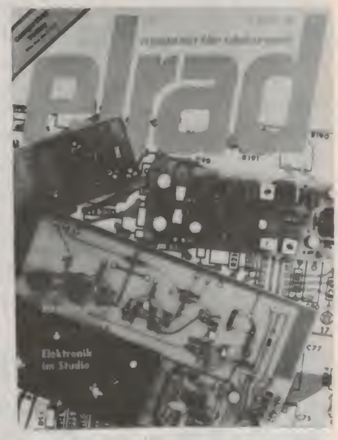
USE IN SURFACE AND SUBSURFACE NAVIGATION

Omega is the only navigation method that is as well-suited for submarines as for aircraft or surface vessels. Its low frequencies penetrate seawater to appreciable depths. They also travel through sea ice. Thus a completely submerged submarine can be guided by Omega through any seas, including those that lie beneath the frozen polar regions. Only reception is required, so the submarine user does not reveal his position.

We reproduced this from the first page of the US Navy's manual on OMEGA — and got a visit from the CIA!

Our first issue!

This issue brought the CIA!



Two of our overseas editions. At left is the December 1980 issue of the British edition, at right a recent issue of the German edition.

NEWS digest

Johnston jumps into Jaycar

Dick Smith's former marketing manager, Gary Johnston, has purchased a controlling interest in well-known Sydney kit and component supply, Jaycar.

Jaycar, located at the Chinatown end of Sussex St in Sydney, has been well-known to the discerning hobbyist after top-drawer projects having superb presentation — known around the traps as 'the Jaycar touch'.

"Jaycar has an absolutely amazing range of products," claims Mr Johnston, "the only problem being that the average enthusiast has not had the opportunity to see this range.

"Unfortunately the company was not strong in marketing and consequently only the very keen hobbyist who ventured into the bottom end of Sussex St ever got the benefit of his efforts.

"Even once he got there he had to ask for everything, for virtually none of the products were on display. If after all this effort he wanted to make a purchase he was not exactly encouraged to do so. Jaycar had no Bankcard facilities and were reluctant to accept cheques. This has all changed now."

Jaycar can be found at 380 Sussex St, Sydney; phone (02) 264-6688 — "a terrible location, but well worth it when you get there".

Our photographer caught Gary Johnston and staff eagerly greeting customers in the street. Gary Johnston is shown holding his hand-drawn Australian flag (can't afford a real one), indicating his 'All-Australian Company' stance.

During the month of April — Royal Easter Show time — Jaycar will have 'sample bags' available to store customers, containing around $40 worth of electronic parts for your junk box (every hobbyist should have one) for a mere $4.50! The bags include such wonderful items as knobs, assorted hardware, a capacitor pack, a kit (wow!), an assortment of semiconductors including a 4K dynamic RAM — and a Phantom comic (double wow!). Rush in now!

Perhaps this should be captioned: "Our highly educated, well trained, intelligent staff are eager and willing to serve you"!

Solar power satellites opposed

Organised opposition has developed to the Solar Power Satellite System (see ETI, April 1979, p.11).

A newly-formed US pressure group, the Coalition Against Satellite Power Systems (CASPS) has launched a campaign to eliminate funding in the United State's Department of Energy's 1981 budget.

The Solar Power Satellite System programme would have sixty 5000 megawatt satellites, each the size of Manhattan Island, in orbit by the year 2025.

CASPS charges severe environmental risk, concentration of control and power in the US Federal Government and industry, development of serious military risks as a weapon and target, and economic unfeasibility.

Supporting the SSPS programme is the L-5 society, a pro-space development group.

CASPS' supporters want Federal money channelled into conservation, decentralised solar energy systems, wind programmes and hydropower.

No doubt individuals amongst the cavemen organised an anti-fire lobby, but history seems to indicate they were left out in the cold. (This was too subtle for Dregs . . . Ed.)

ERRATA

A rather obvious, but potentially dangerous error occurred in the circuit on the top left of page 60 ('Power Monitor') in the March issue. It shows the mains active input connected to the earth at the output. The mains active input should instead go to the fuse. Correct your copy now. Correction slips were inserted in the majority of copies distributed.

Radofin Teletext adaptor

Several channels in the Seven network have been transmitting Teletext programmes for some time, but many people are not aware that they can receive the information available through Teletext on their current TV sets, simply by fitting a readily available adaptor.

Sydney-based Radofin Electronics has released a compact, easy to install Teletext adaptor which can be used with any colour or black and white TV receiver.

The 'Adam 180' Teletext adaptor is an add-on unit connected between the outside aerial lead and the TV set — an indoor antenna will not give satisfactory reception. Tuning is simple and installation takes only a few minutes.

Some of the features available with Radofin's 'Adam 180' are: VHF and UHF input, Teletext at the touch of a button, Teletext superimposed over normal TV reception, double height button to aid people with poor vision, AFC to lock in signal, clock that also automatically turns on Teletext at a preset time, reveal button to show answers to questions, quizzes, etc, subtitle and newsflash capability, handheld remote control, and 12 months' warranty.

Information currently available on Teletext includes news, police news, weather warnings and forecasts, traffic reports, sports and TAB results, share and commodity prices, overseas currency rates, food prices, theatre, travel and Channel Seven programme guide, and children's pages including jokes and riddles.

Recommended retail price for the 'Adam 180' is $575, but Radofin say there may be some pre-duty stock selling at $475 available at some stores. For more information contact Mr M. Skovron or Mr P. Sheining, Radofin Electronics (Aust), 5 Curlewis St, Bondi NSW 2026. (02)309-1957, 309-1904.

We tried the Adam 180 Teletext adaptor and found it worked perfectly, even with poor signals.

Meet J.C. O'Donnell, Altronics

This introduces Jack O'Donnell, proprietor of Perth's dynamic electronic kit and component shop, Altronics.

Known to his partners in cr . . . in the business as "Jeez, Jack" (that's what they utter when he comes up with another of his brilliant marketing ideas), the ever-active Mr O'Donnell has been reputed to perform wonders when it comes to finding sources of components in short supply.

O'Donnell's latest feat was carried out in bare feet in Fremantle harbour when he was apparently spotted walking out to greet the ship just arriving with his latest shipment of goodies for the keen West Australian hobbyist. Jack denies it and quotes Stevie Smith's poem:

'I was much further out than you thought

And not waving but drowning'.

Getting back to the serious business, Altronics started out as the Perth outlet for Dick Smith in 1976 but is now a fully independent, Australian-owned electronics supply house and importer, boasting a "one-stop electronics shop" in Stirling St, Perth and a warehouse in Subiaco, just 2 km away.

Products and components handled are primarily aimed at the electronics enthusiast, although more and more professional lines are being added.

Jack sees direct importing as a key part of his business. He employs electronics enthusiasts and boasts that his 'red hot' mail order service can despatch an order within six hours of receipt, achieving a turn-around of six days or less from the time a customer posts an order. Altronics' motto is "speed and efficiency second to none". Altronics will also wholesale to resellers in all states and offers attractive service.

Personal shoppers should call at Altronics, 105 Stirling St, Perth, phone (09)328-1599. Mail orders should be directed to Box 8280, Perth Stirling St WA 6000.

Jack's latest feat!

Altronics' shop in Stirling St, Perth.

Solar power contest proposed

Amtex Electronics, the solar energy specialists, have proposed that a 'solar power' contest, jointly sponsored by Amtex and ETI, be run at the 6th Consumer Electronics Show in July.

Jim Kuswadi, the proprietor of Amtex, has suggested that the contest be in the form of a race between small solar cell powered vehicles, constructed by the contestants. Are ETI readers interested?

It is proposed that the vehicles be run along a short, straight track, all started simultaneously, first past the post being the declared winner.

Readers wishing to try out their ideas can obtain a set of four solar cell pieces for $10 (plus $1.50 post and handling) from Amtex Electronics, P.O. Box 285, Chatswood NSW 2067.

Those wishing to enter the contest should send a $5 money order deposit to the "Solar Power Race Contest", ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011. This deposit is refundable. There may be a limit imposed on the number of contestants, so be early. Contest conditions, dates, times etc., will be advised to all entrants.

The solar cells offered by Amtex deliver around 0.6 V output each, output power depending on incident solar energy. Connected in series you can obtain 2.2-2.4 V. ETI published an article on solar cells ("The ins and outs of solar cells") in the December 1979 issue.

Good Will instruments for Emona

Emona Enterprises Pty Ltd has been appointed sole Australian agent for all Good Will test instruments.

Good Will Instrument Co. is a leading manufacturer in Taiwan whose products have almost completely taken over the South-east Asian market and have recently also penetrated into the European and American markets. According to Emona, the products are of top quality as a result of stringent quality control and quality imported components.

Good Will's comprehensive range of instruments includes oscilloscopes, function/audio and RF generators, DMMs, frequency meters, ac millivolt meters, milliohm meters, AF/RF attenuators, line filters, capacitance/leakage meters, puncture/insulation testers, regulated power supplies, PA amplifiers, etc. New lines are being continuously added.

Catalogues and additional information are available from Emona Enterprises Pty Ltd, 661 George St, Sydney NSW 2000.

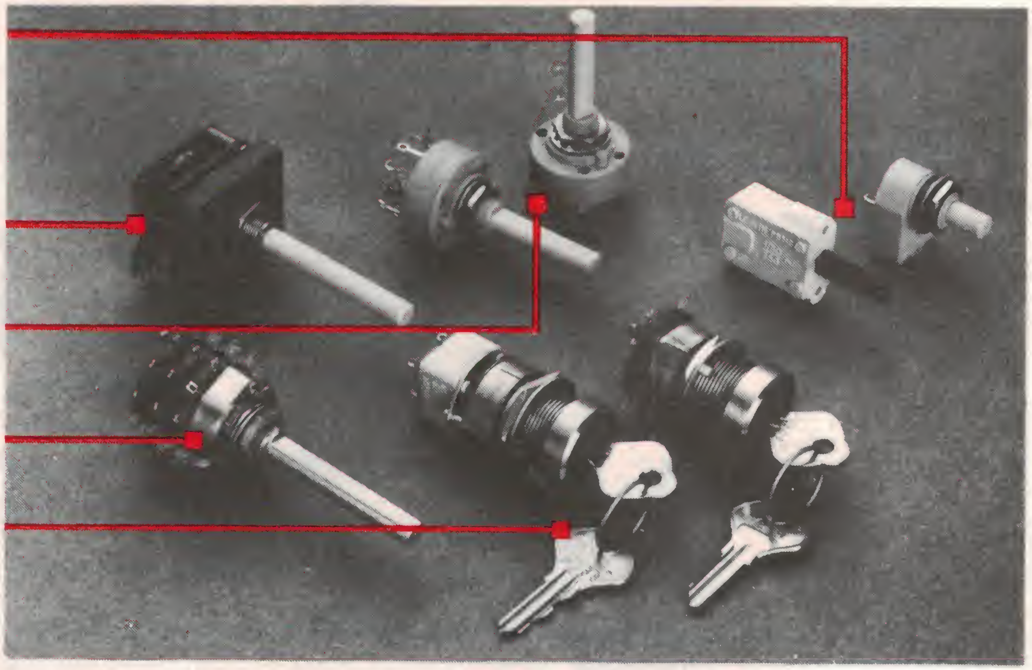
'81 Consumer Electronics Show

The sixth annual Consumer Electronics Show will be held on July 20-26 at the Yennora Woolsheds, Sydney (that's somewhere in the depths of the Western Suburbs, for those of you who were wondering).

The transfer of venue from the Sydney Showgrounds has been made to give larger numbers of the buying public easier access to the Show; some shows held at the Yennora Woolsheds have attracted as many as 200 000 or more visitors! The new venue also allows all the exhibits to be placed under one roof.

Manufacturers like Philips, Sanyo, Pioneer, Bose, Hanimex, National Panasonic, Hitachi, Kriesler, Monier, Sunbeam, Rank, Tandy, Sansui, Ansa-Phone, Texas Instruments and Sharp — to literally name only a few — exhibited products in 1980 ranging from electric toothbrushes to videodisc players and almost every electrical appliance in between, so it's a good chance for the potential buyer to see what the various companies have to offer without having to trek round from shop to shop.

LORLIN supa-switches from C&K



MAINS SWITCHES

Type MS — Rotary action DPST, suitable for inductive circuits.

Type PBMS — Pushbutton (push on/push off). Ideal for TV industry. Both types 4A at 250V, 80A. surge.

PRINTED TRACK SWITCH

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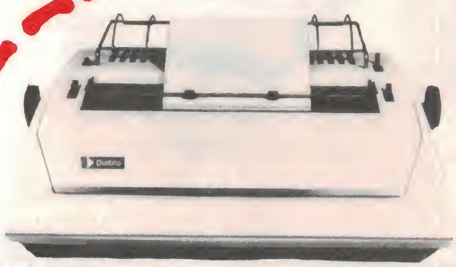

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131 Sturt Street, Sth Melbourne.

The negative ion generator

— product of the future, or no future for the product ?

Apart from electrons, ions and ozone, a cloud of suspicion hangs around negative ion generators. And not without reason. 'Hard' evidence to support the myriad claims made for them is difficult to come by. We hope this article provides some background to readers wanting to investigate the subject for themselves.

Dee Warring

THE 'NEGATIVE ION INDUSTRY' is booming. In the last three years in the United States the number of companies manufacturing negative ion generators has jumped from three to fifty-seven.

In Australia, the two companies which have been importing generators for several years, Bionic Products and Wentworth Electronics, were joined last year by several other importers and the first Australian manufacturer.

Buyers and users of generators are said to come from all walks of life and from all parts of Australia — parliamentarians, surgeons and GPs, hospital staff and patients, office workers, shop workers, mothers and health nuts. They pay anywhere between $85 and $300 for a generator. Considering the simple construction of the devices this seems a high price, but the manufacturers argue that their prices are not high considering the benefits people can expect to gain. They claim that the generators will give you a feeling of relaxation and well-being, clean the air of tobacco smoke and bacteria, increase concentration and alertness, and give relief from asthma, allergies, bronchitis, sinusitis and migraines. Asked why the prices are so high, Joshua Shaw, manager of Bionic Products, said: "If you're an asthmatic and faced with paying out $500 every year on drugs for the rest of your life, to spend $300 on a machine which can cure you for life seems a small price to pay."

The manufacturers also claim that the high cost of research has forced the prices up. Worth it or not, the list of benefits ascribed to negative ion generators is growing embarrassingly long. It is hard to believe that these small black boxes can do so much.

The Hungarian-made Bion-79 by Medicor is a mains-powered unit.

They are not a new invention. The Nazis were apparently using them during WWII to keep crews more alert in U-Boats. Throughout the 1920s and 1930s scientists in Europe — in Germany particularly, and in Japan and Russia — had conducted experiments that led some to claim that ions had a pronounced effect on all life forms.

With the outbreak of the Second World War, ion science was suspended as scientists were put to work devising war machines. After the war, the new sophistication in electronics led already sceptical scientists to disregard earlier ion science on the grounds that the measuring techniques that had been used were suspect. Even now there is a scarcity of studies being done under properly controlled conditions.

Lack of money in the form of grants has also hampered the progress of research into the subject. ▸

Regulations

Negative ion generators have not yet been made a proscribed article in Australia, which would make it mandatory for every model to be submitted for testing and approved before sale. The Energy Authority of NSW is investigating some of the products on the market to see if they comply with the Standards Association of Australia wiring specifications.

The lack of regulations governing ionisers worries some of the distributors, who fear that negative ion generators will become just another gimmick with everyone trying to sell them and make a fast buck. Most concerned is Joshua Shaw. "If you gimmickise ion generators," he said, "we will have the same thing happening here as happened in the States."

In the 1950s the US Food and Drug Administration (FDA) banned the sale of ionisers to the general public. US companies had been commercially exploiting the units as cure-alls and some devices were found to produce unsafe levels of ozone.

Because of its highly oxidising properties, ozone is very effective in neutralising smells and has in the past been misrepresented as being equivalent to "invigorating mountain or sea air". However, ozone is highly toxic and has been shown to accelerate the aging of blood cells. The legal limit allowed by the FDA is 0.05 parts per million, and the FDA still only allows the sale of air ionisers for environmental, not medical applications.

In Australia, the Commonwealth Department of Health approves air ionisers for personal use. It considers that *they have no scientifically proved benefits but that they present no health hazard.*

It is against the law to make claims of medical benefits in advertisements for ionisers.

This hasn't deterred some distributors. Bionic Products' advertising, for example, claims 85% alleviation of asthma, 70% alleviation of migraines, and 90% alleviation of hay fever and sinus.

In 1979, the Health Commission of NSW wrote to Joshua Shaw warning him to cease making such claims. Shaw ignored the warning. He says he wants to be prosecuted because he's so sure he would win the case.

"Within 24 hours, I'd fly in Dr. Sulman from Jerusalem and Dr. Krueger from California with enough evidence to convince any jury," he said.

Dr. Felix Sulman MD, of the University of Jerusalem, Israel, and Professor Albert P. Krueger MD LLD (Emeritus Professor of Bacteriology at the University of California) are two of the world's most famous ion researchers.

Dr. Sulman's research has centred on the effects on humans of the Sharav — the hot, seasonal wind which blows out of the deserts of the Middle East. The Sharav is one of the world's notoriously 'evil' winds, known everywhere as 'Witches' Winds'. These include the Santa Ana in California, the Chinook in Canada, and the Foehn in Germany, Austria and Switzerland. Australia, too, has its 'Witches' Winds' — the north winds of Victoria and the westerlies of NSW.

When these hot, dry winds blow they are apparently accompanied by an alarming increase in the incidence of murder, suicide and car accidents, and people complaining of asthma attacks, aching joints, depressions, unbearable tensions or just feeling "under the weather".

What all Witches' Winds have in common is a very high concentration of positive ions. Research done by Sulman and other scientists purportedly shows that an excess of positive ions increases the production of serotonin, an important neurohormone.

Serotonin is a depressant and is associated with sleep, mood and the transmission of nerve impulses. Too much serotonin, it seems, can result in sleeplessness, fatigue, irritability, headaches and dizziness, nervousness, inability to concentrate and a sharp reduction in physical and mental efficiency.

When the Sharav blows, Dr. Sulman found that some people overproduced serotonin as much as 1000 times. Negative ions apparently decrease the production of serotonin in the brain,

HOW A NEGATIVE ION GENERATOR WORKS

This is a brief description of the physical aspects of the operation of an air ioniser or negative ion generator and should not be taken as a rigorous explanation of how they work. Suffice to say that the physics of the process appears to be poorly understood in detail — or is a proprietary secret!

The point

We know from basic physics that a sharp conductor raised to a high potential will have an intense electrostatic field around the point — as illustrated in Figure 1. If the conductor is at a high negative potential, free electrons from the metal will flow towards the point, and if the potential is high enough some will be repelled from the point. The latter will occur because electrons, having a like (negative) charge, will repel one another and the mass of electrons building up behind the conductor's tip will repel those electrons at the very tip. At a certain potential the air will 'break down' and a spark will be seen to emit from the conductor's tip. Catastrophic ionisation of the air occurs, photons being emitted in the process — thus we see a spark along the path of ionisation.

However, at potentials well below the air's breakdown potential, the electrons leaving the tip of the sharp conductor are found to combine with gas atoms and molecules in the air.

Most of the atoms and molecules of the gases comprising the air we breath will have 'vacancies' in the outer electron shell of the free atoms or in the outer electron shell of at least one of the atoms in the gas molecules. Electrons escaping from the conductor will 'fill' these vacancies, giving the atom or molecule to which it attached a net negative charge; this is how they become negative ions.

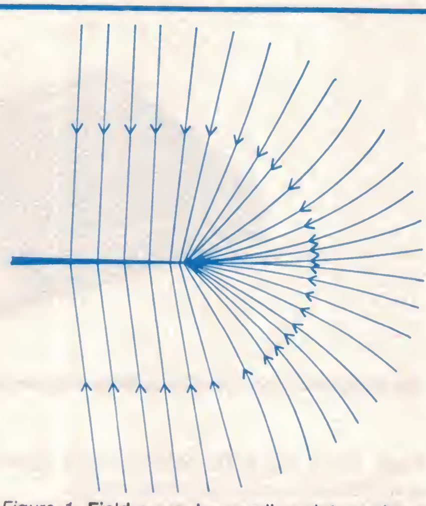


Figure 1. **Field around a needle-point conductor raised to a high potential.**

These ions, termed "small" or "primary" ions, may then combine with other molecules or ions to form larger ions of various sizes and mobility. Research indicates (. . . as all good review papers say) that it is the small primary ions that appear to be "biologically active", while the larger ions appear to be inert — see Robinson and Dirnfield (1963), Krueger and Reed (1976), Krueger and Smith (1960) and Kranz and Rich (1961).

If, for some reason, some of the atoms and molecules of the atmospheric gases have been positively ionised (that is, they are deficient an electron or two) then the electrons streaming from the conductor's tip will be attracted to the positively-charged ion, neutralising it when they combine.

Again, "research indicates" that an excess of positive ions in the air is biologically deleterious. See Kimura, Ashiba and Matsushima (1939), Sulman (1962) and Sulman et al (1974).

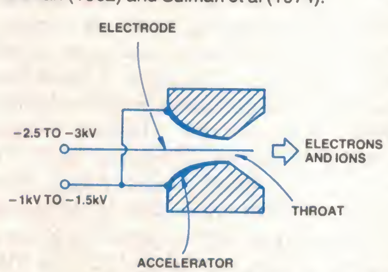


Figure 2. **Simplified cross-section of the emitter head of a commercial air ioniser.**

Heads

A cross-section (simplified) of the 'emitter' of a commercial negative ion generator is shown in

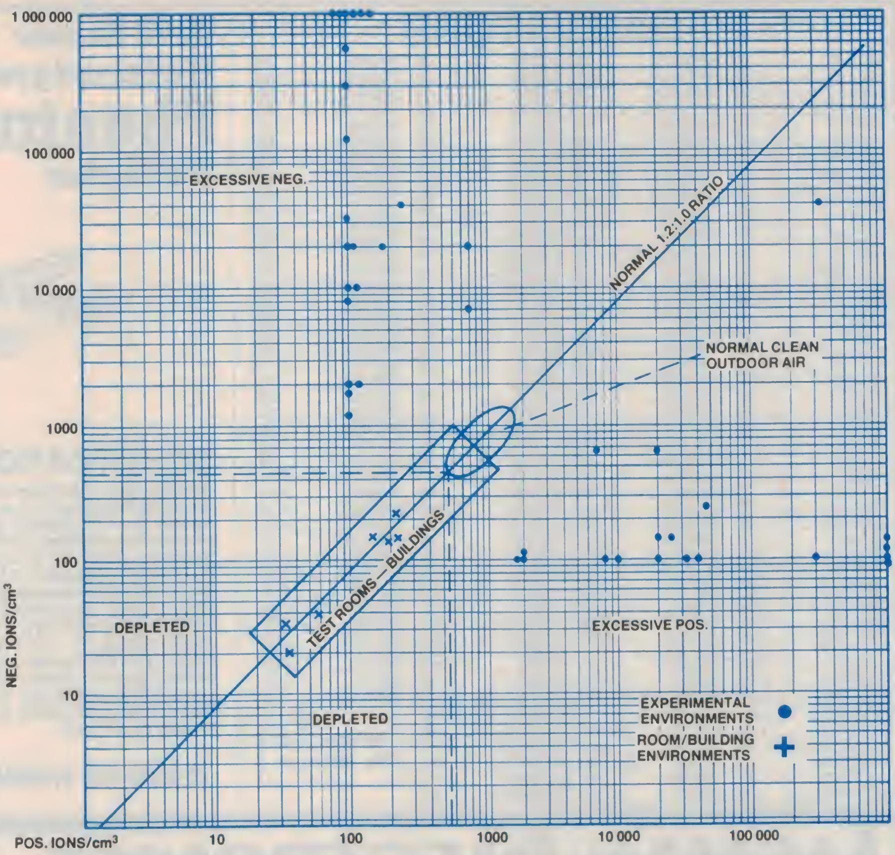
resulting in a calming, tranquillising effect.

Negative ion imbalance or ion depletion is at its worst in cities. For a worthwhile environment there needs to be between 1000 and 5000 negative ions per cubic centimetre, according to various researchers. The average city worker spends his day breathing air with only 200 to 300 positive and 150 negative ions per cubic centimetre. Air pollution in cities quickly depletes or neutralises negative ions, which attach themselves to positively charged pollution particles and lose their charge. This leaves an abundance of positive ions which, along with the pollution particles, are then inhaled.

Negative ions and tobacco smoke

Experiments in the mid-1960s showed that the cilia (microscopic hairs) of the trachea, or windpipe, are stimulated by negative ions and depressed by positive ions.

These microscopic hairs under normal conditions maintain a whiplike motion of about 900 beats per minute while cleaning the air we inhale of dust, pollen, and other matter that should not reach the lungs. Subjected to tobacco smoke, which absorbs negative ions, the cilia slow down; tobacco smoke plus positive ions make this slowing down take place from three to ten times more quickly. This obstructs the ability of the cilia to clean the air that finally ends up in our lungs. ▶



This chart, from a review of the subject by K.R. Robertson of the University of Auckland (see Bibliography), shows "... various types of air ion environments and the relationship of existing research to these environments. Only experiments dealing with humans are presented. The 45° line represents the balanced negative-to-positive ion ratio of 1.2:1.0 across the environments of depleted, normal fresh outdoor, and excessive ion concentrations."

The points and crosses marked on the graph represent measurements of ion environments taken in buildings and test rooms and type of ion environment created in various research designs (base ion count assumed to be 100 +ve and 100 −ve ions per cm³ of air for test rooms).

Figure 2. The 'electrode' has a potential of around −2.5 kV to −3 kV applied. The 'accelerator' has a potential of around −1 kV to −1.5 kV applied. This makes it more positive than the electrode. The shape of the accelerator produces a very complex electrostatic field between itself and the electrode. The apparent object is to 'push' more electrons toward the tip of the electrode. The latter projects well beyond the throat area of the emitter head and the electrons and (negative) ions stream away from the emitter in the direction indicated. Some electrons will accumulate on the flared portion of the throat, giving it a slight negative charge, but this is generally quite small.

The object of the design of the head is to produce a large number of mobile small ions, and as little ozone as possible.

Ozone

There's a drawback that has to be avoided — the production of ozone, O_3. This is a highly reactive form of oxygen that is a good reduction agent or oxidiser and has a known deleterious effect on the mucous membrane and lungs of animals and people if inhaled in quantities above a certain level. (The US FDA sets this level at 0.05 ppm). Ozone is that distinct, acrid, somewhat 'coppery' smell apparent near any continuous spark discharge.

Circuitry

The voltages applied to the emitter are generally derived from a simple Cockcroft-Walton voltage multiplier with input direct from the mains — as shown in Figure 3. The component values used and the addition of a high value series resistor between the rectifier output and the emitter's electrode serves to reduce the possibility of nasty accidents if you happen to touch the electrode of an air ioniser — the short circuit current is only tens of microamps. Nevertheless, we recommend you *do not* dismantle one.

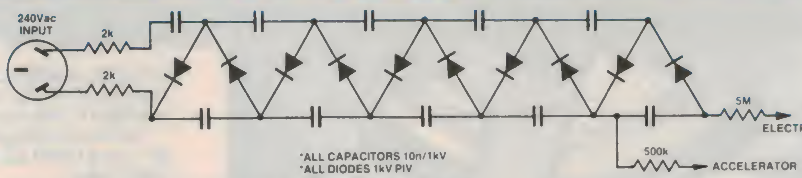


Figure 3. **Circuit of a commercial negative ion generator.**

The result

What happens, or is claimed to happen, with an air ioniser in operation you can read about for yourself in the numerous research papers. Certainly, the 'coronal wind' produced by one will rapidly precipitate pollutants in the air — particularly those in tobacco smoke. If an air ioniser is operated in one position in a room for some time the surrounding area will become coated in a sticky, dark film of material — which presumably you would otherwise have breathed in. Just why, and how, an air ioniser does this is not clearly apparent.

Trotting out that phrase again, "research indicates" . . . that an air ioniser will have a decidedly destructive effect on bacteria. It's controversial, but this is generally attributed to the ozone produced.

Many claims made of air ionisers relate to 'restoring' the 'natural' balance of negative-to-positive ions. For a machine to do this, clearly, it would need to produce not only sufficient electrons to neutralise the positive ions in the atmosphere surrounding it, but sufficient to balance the ratio as well. As the machines are clearly quite simple at present, no 'feedback' of ion production or negative-to-positive ion ratio is employed, so their effectiveness under variable or uncontrolled conditions must be hard to gauge and their 'control' of the environment crude at best.

If you accept that an excess of positive ions in the atmosphere (as in the 'Witches Winds') can have a detrimental effect on some people, and you believe than an air ioniser has the ability to restore the natural balance of positive-to-negative ions, then you could accept that the machines may have a positive effect (no pun intended).

At this stage, we leave you to decide for yourself.

Roger Harrison.

An article in *New Scientist* for 2 October 1980, entitled "The perils of second-hand smoking", by Sherridan Stock, (pages 10 to 13), said: "Tobacco smoke removes negative ions from the atmosphere, which is already grossly depleted of its natural complement by urban pollution and various other factors associated with modern, man-made environments . . . In recognition of this effect of tobacco smoke, some company executives have installed negative ion generators in their offices and conference rooms."

The article also reported on the effect of secondary smoking (breathing in other people's smoke) on the cilia. Poisoning the action of the cilia by tobacco smoke is believed to facilitate the development of lung cancer by causing the retention of inhaled carcinogens (a substance or combination of substances that can produce a growing cancer from normal cells).

An excess of positive ions in the atmosphere also reduces the body's ability to absorb oxygen and therefore cuts down lung capacity.

Accepting all this, it is then possible to believe that negative ion generators do have a beneficial, if not curative, effect on respiratory ailments. But 'hard' proof is lacking, particularly with respect to the required production and mobility of negative ions to counteract positive ions and pollutants.

Air ionisers in the office

Manufacturers of air ionisers are looking increasingly at the potential market for their products in offices. The combination of air-conditioning, cigarette smoke, synthetic furnishings and large numbers of people in a confined space creates problems in offices ionically speaking.

Hot or cool air forced through duct work of central heating and air-conditioning systems sets up friction that can bring about a reduction of negative ions in the air, according to several researchers. What finally comes out of most heating and air-conditioning outlets in the offices we work in is likely to be an eternal Witches' Wind. To make matters worse, most modern offices are carpeted with synthetic fibre which, as we walk across it, tends to generate a positive charge in the air.

Bacteria thrive in positive ion atmospheres, so besides having to cope with positive ion-induced fatigue, loss of concentration, irritability, tension and headaches, there is also the problem of spreading of disease.

One widely-reported study of the effect of ion-depleted air on office workers was carried out in the New York Swiss Bank. Between January and March of 1973, at a time when there was an epidemic of 'London Flu', negative ion generators were placed in two working areas of the bank and left running throughout the three-month period. Both areas had 16 people working in them, who were told only that the machines were 'air cleaners'. At the end of the test period it was found that of the 32 employees, only nine were absent for two or more days, and that a total of 53 days' work was lost through sickness. The year earlier (during the same three months) every one of the 32 people was off for two days or more and a total of 89 days of work was lost.

Air-conditioning manufacturers in the States — like Westinghouse, General Electric and RCA — are now designing new systems that increase negative ionisation.

Vehicles

Cars are also said to be ion-depleted atmospheres. Traffic exhaust fumes destroy negative ions, and friction between the air and the vehicle as it is moving sets up a positive charge on the metal bodywork that attracts negative ions to the metal.

A subjective investigation into the effects of ionisation on truck drivers was conducted in Australia in 1979. Drivers from all over Australia were sent a questionnaire to complete. A negative ion generator was installed in each truck and drivers were instructed to make weekly reports.

The results were: 81% of drivers reported an increase in alertness and awareness while driving; 13% could not discern any difference. 80% stated that they slept better and deeper for shorter periods. 73% said they had become less irritable, while 27% found no difference. 93% said they found their cabin cleaner and fresher. 7% failed to comment.

Burns, asthma and negative ions

Dr. Igho Kornblueh of the American Institute of Medical Climatology explored the use of negative ionisers in the treatment of burn patients at Philadelphia's North-eastern General Hospital. After a number of controlled experiments using ionisers in which 57% of burn patients showed improvement, rapid healing and less pain, the entire hospital's post-op wards were equipped with ionisers.

Dr. Kornblueh was also responsible for introducing negative-ion treatment for hay fever and bronchial asthma patients at two major hospitals in Pł. ladelphia. Of the hundreds of patients treated, 63% experienced partial to total relief.

"They come in sneezing, eyes watering, noses itching, worn out from lack of sleep, so miserable they can hardly walk," one doctor said. "Fifteen minutes in front of the negative ion machine and they feel so much better they don't want to leave."

A two-year study of the effect of negative ions on asthmatics is presently in progress in England.

The local scene

We could find no local research efforts into the negative ion question being carried out by independent scientific bodies. However, several of the local air ioniser equipment suppliers said they were carrying out some investigations. Pat Mulligan of Creative Electronics, who markets air ionisers under the aegis of Bionaire International, has spent the past 15 months or so gathering documentation on the subject and is ". . . keeping a low profile in the market" while his researches continue.

Joshua Shaw of Bionic Products has been doing some work on the construction and operation of air ionisers. He claims to have spent half a million dollars already in funding research. The most recent project financed by his company is an investigation of the size and mobility of ions produced by air ionisers. It seems these are the two most important factors influencing their effectiveness.

"Ion mobility is one of the toughest nuts to crack," said Joshua Shaw. He is waiting for the results of this latest research before going into generator manufacture himself. Even so, he plans to be manufacturing six models in Australia within a year. In the meantime, he is content to watch sales of his imported models grow higher every day. Since he first started importing two years ago, he claims to have sold 6000 generators.

Shaw first became intrigued by negative ions in 1969 after the presence of a negative ion generator healed a bad burn on his arm. He immediately wrote to the manufacturers to find out more about the machines. Nine years later he brought in his first shipment of generators and he hasn't looked back since.

Bionic Products have six models on the market at present. Two of the most popular products are the Mobilion and Modulion, both made by Amcor — the 'General Electric' of Israel.

The Mobilion is a 12 V car model, the Modulion a room model. It operates from the 240 Vac mains and is claimed to produce an output of 250 billion negative ions per second.

Shaw also imports two models from Medion Limited, a British firm which ▶

Inside the Medicor Bion-79 — simple, isn't it? The basic circuit of this machine appears on page 17.

has been in the ion business for many years. The Medion desk model is claimed to have an output of 5×10^9 to 10^{10} ions per second and an effective range of four to five metres. The Medion portable is claimed to be the only battery-operated unit in the world. Its output and range are similar to the desk model.

Bionic is the only company in Australia, and one of the few in the world, to possess an Atmospheric Ion Analyser (also made by Medion) according to Shaw. The Analyser measures ion charges of either sign independently and the three scale ranges enable density of between 50 and 250 000 ions per cubic centimetre to be recorded. With this, Shaw has tested the effectiveness of all the generators currently on the Australian market. He reports that three of his products gave the following results:

Mobilion — 100 000 ions/cc (measured at 1m),
Medion — 110 000 ions/cc.
Medion (portable) — 60 000 ions/cc.

Another well-established company in Sydney is Wentworth Electronics. The director, Ian Maclachlan, has imported, manufactured and sold electronic equipment, particularly electronic health aids, for some years. Since 1977 he has been importing generators from Hungary and has recently started to import from Germany. His range includes desk and car models, a large room unit, appliances for special medical use and a car unit with an electrostatic ceiling strip "designed to produce the same ion conditions in the car as are found outside". Prices range from \$68 for a car unit to \$295 for a specialised medical unit.

Wentworth Electronics claims to have sold over 2000 units.

Bionaire International (Creative Electronics) imports American- and Canadian-made ionisers. They avoid any medical claims and stress only their benefit as air fresheners and purifiers.

Bionaire has three models — the Bionaire 300, a car model priced at \$159, the Bionaire 100-A for caravans (\$169) and a large spherical room model, the 'Ionosphere' (\$159).

Autex International is a Queensland-based company specialising in car accessories. It markets an American automobile ioniser unit called Air-Alive, which plugs into the cigarette lighter and costs \$139. Autex markets the machine as an air freshener and makes no health claims.

The latest product on the market is a room unit assembled in Australia from American components for Ion Environment Australia of Sydney. Called the Saucer, it is priced at \$136.

The distributors vary in their approach to the product. Some stress health benefits and will only sell directly to the public. Others rely on the benefits of clear and fresh air, and some would like to see ionisers widely sold through retail outlets.

Shaw of Bionic Products believes in a personalised service. "I only sell eyeball to eyeball," he said. He has a small sales team who "know everything there is to know about ions and ionisers". A 12-month guarantee comes with all models. If there are any complaints or faults the company immediately replaces the faulty model or refunds the money.

Gerard Marceau of Belle Lumiere, Australia's only manufacturer of negative ion generators, is one distributor who would like to see generators sold through a wide range of retailers. The company recently ran an intense advertising campaign through electronics magazines and on radio promoting their product, the Aironic.

"We want people to know us so well that when they think of negative ion generators they will think automatically of the Aironic," Marceau said.

The company is also about to launch two new products — a car model and a larger model, twice the size of the Aironic, for industrial use.

Two hundred Aironics are produced each week in the company's Lane Cove (Sydney) factory — and they're going like hot cakes, says Marceau. At \$57 wholesale and \$85 retail, the Aironic is one of the cheapest generators on the market but is also one of the simplest designs; Marceau himself admits than an amateur could make one.

Belle Lumiere moved recently to safeguard their product when they had a 25% import duty on generators introduced in November last year. When asked about this, Shaw of Bionic Products said he wasn't at all concerned. He is more worried about the retaliatory actions of the drug companies who, he says, stand to lose billions of dollars in lost drug sales if the ioniser market keeps growing at its present rate. And according to the ioniser manufacturers, it will happen.

"One day there will be a negative ion generator in every home." ●

The Biotech from Bionaire International is powered from a 12 Vdc source and intended for use in cars, trucks, etc. The makers claim it produces 10 billion ions per second.

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BIOGRAPHY — DEE WARRING

Dee Warring is a 23-year-old New Zealander now living in Sydney. Dee trained as a journalist at Wellington Polytechnic in 1978, specialising in investigative reporting and feature writing. A feature on rape earned her a special prize and was published the same year in a national newspaper. The following year Dee worked as a general and court reporter on a provincial newspaper.

The desire to see another country and expand her career brought Dee to Sydney in January last year. Since then she has been doing some freelance writing for public relations firms. This is the first major article she has had published in Australia.

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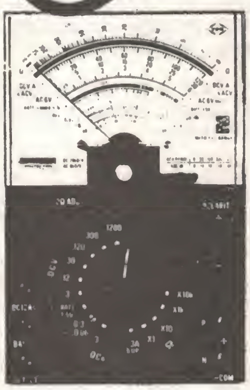

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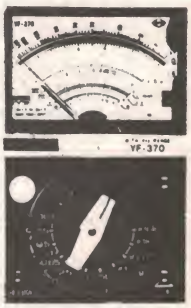

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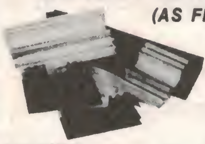

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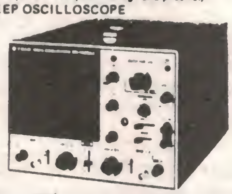

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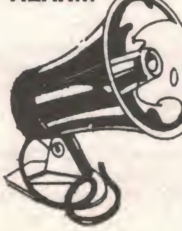

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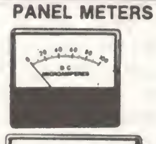

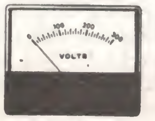

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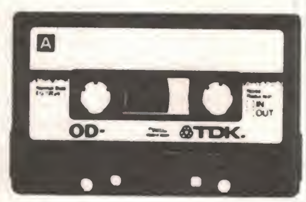

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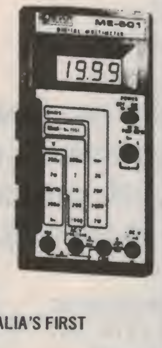

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Encounter with Saturn

Brian Dance

Voyager I has moved on from its brilliantly successful mission to Jupiter to produce spectacular high-definition pictures and a lot of provocative information about Saturn, its rings and its moons.

PIONEER 11 relayed close-up pictures of Saturn as early as August 1979, but the image quality of those received from Voyager I at its encounter with Saturn in November 1980 is far superior. Voyager I has a more sophisticated colour-imaging system as well as a better communications system, with a 3.7 m diameter antenna for returning data to Earth at a greater rate and with fewer bit errors. Voyager's instruments even weigh nearly four times as much as those of Pioneer 11.

The Voyager spacecraft are the most elaborate unmanned vehicles ever launched. Voyager I set off in September 1977, passing by Jupiter in March 1979 and returning brilliant pictures (ETI, June 1979); Voyager II followed a slower trajectory and gave similar high-quality images of Jupiter and its moons in July 1979 (ETI, January 1980). It will reach Saturn in August 1981, from where it will go on to visit both Uranus (January 1986) and Neptune (November 1989) in the outer planetary system.

Communications

The Voyager spacecraft contain highly sophisticated electronics and instrumentation systems with which to observe, take measurements and radio the information back to Earth. Radioisotope thermo-electric power generators on a boom attached to the craft provided about 430 W of power at Saturn encounter.

The transmitters on Voyager return data in the S-band (2 GHz) and in the X-band (8 GHz) to the three Deep Space Network receiving stations in California, Spain and Canberra. At least one of these stations can 'see' the spacecraft at all times, unless a large object intervenes between Voyager and Earth. The Deep Space Network stations were able to receive a data rate from Saturn of 29.9 kilobits pers second; at a distance of some 1500 million km (about 950 million miles) the signals took nearly 1½ hours to reach the Earth.

The imaging cameras on board Voyager I provide some of the most spectacular information, but these images are only a part of the experimental work, which as a whole will take scientists years to analyse. The cameras viewed Saturn separately through red, green and blue filters so that images closely approximating to the correct colours could be reconstructed on Earth, and they could be pointed in any desired direction. The raw images appear to contain little information, but under computer enhancement brilliant images are obtained. For example, a hardly noticeable 10% variation in the amount of light reflected from two parts of an image can be enhanced to extend from full black to full white or over full colour.

Each image consists of 800 x 800 picture elements, each of which is stored as a computer word of eight bits which can represent up to 256 levels of intensity in a particular colour. These images are sent around laboratories by closed circuit television and stored on magnetic data tape for transfer to other laboratories for study.

Saturn's rings

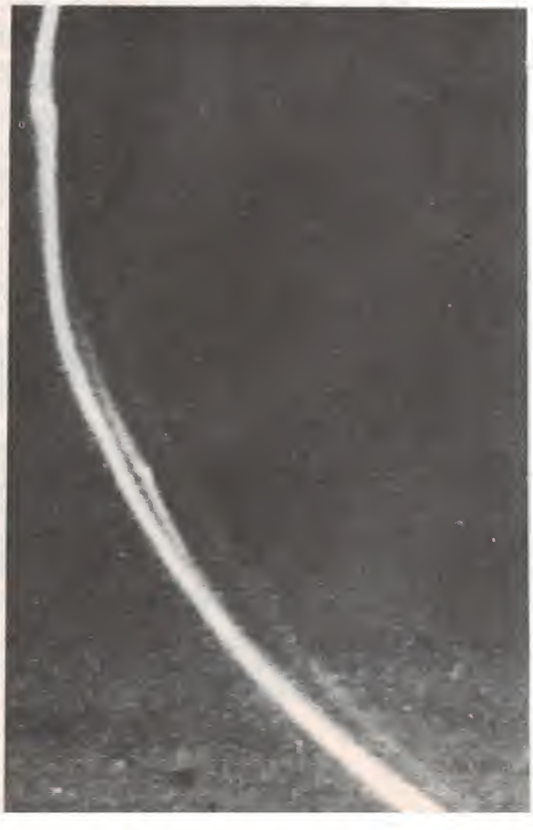
Ever since Galileo first saw the ring system of Saturn through his telescope in 1610 (he mistook the rings for separate moons), man has been fascinated by it. However, we have learnt less about this system in the last 3½ centuries than in the one week that Voyager I was returning data.

It had been believed that Saturn had six rings, which had been named from 'A' to 'F'. Since Voyager's encounter, however, it seems that there are about 500 concentric rings, some of which behave in very peculiar ways.

The wealth of detail which appeared in the rings as Voyager approached them was a surprise. From Earth the two bright 'A' and 'B' rings only can be seen, the outer ring 'A' being separated from 'B' by a dark gap known as the Cassini Division. The Voyager images have shown that each of these rings in fact consists of large numbers of less distinct rings, and even the Cassini Division contains many rings of thinly distributed material, which reflects such little light that it is only visible as a dark region from Earth.

Inside the 'B' ring is the smaller 'C' ring, and on November 10 1980 (two days before its closest approach to Saturn) Voyager I returned images which indicate that two eccentric rings are also present — one in the 'C' ring, and the other in a dark gap near the outer edge of the Cassini Division. These eccentric rings are puzzling scientists considerably, since they do not seem consistent with current theories.

Saturn's outermost 'F' ring observed from the un-illuminated face of the rings by Voyager I at a distance of 750 000 km. Two narrow, braided, bright rings are seen which trace definite orbits, together with a broader diffuse component 35 km wide. The 'knots' may be small moons, but are probably clumps of ring material. (JPL).



Pioneer 11 discovered a thin ring only about 95 miles in width (named the 'F' ring), outside the bright 'A' ring. Voyager I enabled observation of irregularities in this ring, known as 'braiding' because of the impression given of a twisted thread. Images of this 'F' ring from Voyager I show that it probably consists of three component rings, two of which seem to cross each other to give this 'braided' appearance. This effect is also a great puzzle to scientists, since it seems to defy the simple theories of orbital mechanics.

The 'F' ring also appears to have 'knots' in it; it could be that despite its thinness the 'F' ring has enough material to give rise to gravitational interactions, and the 'knots' may be pieces chipped off larger bodies by meteors and subsequently imprisoned in the 'F' ring. NASA has decided to send commands to Voyager II to investigate the behaviour of this ring further when it encounters Saturn in August 1981.

Another puzzling feature of Saturn's ring system is the dark radial markings known as 'spokes' in the 'B' ring. These spokes appear dark when viewed in the light reflected from the ring system (as seen from Earth), but when Voyager I had passed underneath the ring system, allowing it to be viewed with the light from the sun passing through it, the spokes appeared bright against the darker background of the 'B' ring. The spokes cannot therefore be gaps in the ring system or they would appear dark from both sides of the rings; the spokes must scatter sunlight in a forward direction instead of reflecting it back to the sun. This seems to imply that the particles in the spoke regions must be very small — not appreciably larger than the wavelength of the light they are forward-scattering. Bradford Smith of the University of Arizona has suggested that the spokes may be regions elevated above the plane of the ring itself, possibly by forces due to electromagnetic fields.

Voyager I has shown that, as expected, the Saturnian ring system extends right down to the cloud system above the planet. This discovery was made by Voyager on the opposite side of the rings from the sun; very small particles in the 'D' ring (the innermost rings) forward-scatter light from the sun, thus becoming visible to this depth, unlike from Earth.

Voyager I also detected the diffuse outer 'E' ring, which extends about 500 000 km from the surface of the planet. Saturn has a radius of about 60 000 km, whilst the radius of the 'F' ring is about 2½ times that of the planet.

Ring material

When Voyager I was on the far side of Saturn's ring system, it sent out radio signals to Earth to try to discover the constituents of the rings by their absorption of these radio signals. In order to maximise the power of these signals, all other communications systems within the spacecraft were cut off for five hours whilst these experiments and others concerning Saturn's main satellite, Titan, took place. During this time all data on the other experiments were stored on magnetic tapes for later transmission, so that no information was lost. These radio experiments alone have generated some 400 full reels of magnetic data tapes about Saturn and Titan. Analysis of these tapes will continue for years, and it is hoped that the information gained about Titan's atmosphere will provide clues as to how our own atmosphere developed.

It had already been conjectured through radar experiments from Earth that the particles making up the main rings of Saturn could be largely ice water containing impurities — 'dirty snowballs', as they have been called. The absorption of the radio signals from Voyager indicates that at least in the 'C' ring the particles may have diameters in the order of 1 m, although the earlier radar experiments suggested diameters considerably smaller than this. No conclusions seem able to be drawn about the constituents of the rings; there are considerable differences throughout the system.

We are therefore still left with many questions unanswered about the composition and origin of Saturn's ring system. It may have been formed from moons which broke up due to tidal forces, but then one would expect the constituent particles to be several km in diameter. It could have condensed out of the remaining gas after Saturn was ▶

This computer-assembled two-image mosaic of Saturn's rings, taken on 6 November 1980 from a distance of eight million km, shows about 95 individual concentric features in the rings. The ring structure is now thought to be too complex to have been produced by the gravitational interaction of the moons and the ring particles. The fourteenth moon can be seen just inside the narrow 'F' ring near the tip of the rings; it is less than 150 km in diameter. (JPL).

formed; in this case, the particles should be small. The origin and constituents of the rings remain a mystery.

Saturn itself

Saturn is a relatively inactive planet with few prominent markings and fewer colours than Jupiter, although it does have a red spot in its southern hemisphere and a few less prominent red spots in the northern half. It is unknown whether these are similar to Jupiter's famous red spot, thought to be red phosphorus. There are also some brown oval markings on Saturn's disc of equally unknown origin and composition.

Voyager found markings on the surface of Saturn which enabled the pattern of atmospheric movements to be estimated; the constant 900 mph west-to-east wind was a surprise. The temperature of Saturn's clouds seems to be around −176°C (roughly the temperature of liquid nitrogen); Jupiter has a somewhat warmer atmosphere at around −150°C. The low temperature of Saturn may explain the lack of colour on its surface, and the formation of clouds deep below the inversion layer, with small particles being carried to the top of the inversion layer by convection currents and creating a fine haze, prevents us from seeing the true cloud tops.

The ultra-violet spectrometer on board Voyager I provided a new view of the cloud of neutral hydrogen gas surrounding Saturn in the same plane as its rings and moons. It seems likely that this neutral hydrogen has emanated from the atmosphere of Titan, where methane could dissociate to produce hydrogen gas. It was suspected that the hydrogen formed a torus (doughnut-shape) around the orbit of Titan, but the ultra-violet spectrometer has shown that this cloud of hydrogen extends over a large volume, surrounding the planet from the orbit of Rhea (about eight Saturnian radii from the planet) to just outside the orbit of Titan (some 25 Saturnian radii). This hydrogen cloud is very tenuous (only about ten atoms per cm^3) and the total mass is about 25 000 tonnes — a figure which agrees with some previous theories.

Titan

Voyager I discovered three previously unknown satellites orbiting Saturn: S15, on the outer edge of the 'A' ring, which was found about the time of Voyager's closest approach to the planet; and S13 and S14, which seem to interact gravitationally with the 'F' ring and hold it in place.

However, most of the interest in the moons of Saturn is in the six largest, listed in Table 1. Of these Titan is by far the largest, and is unique among all the planetary satellites in that it has a dense atmosphere.

Titan, like Venus, is obscured by clouds, which meant that Voyager I was unable to get a glimpse of its surface. Titan is so important to research that it had been decided to program Voyager II to investigate it if Voyager I failed to provide information, thus preventing Voyager II from continuing its journey to Uranus and Neptune, but fortunately Voyager I succeeded in returning the required data. This will be the last such detailed information from Titan for many years, as Voyager II will not pass so close to it.

Voyager I passed by Titan at a distance of just under 4500 km on November 12 1980, just before the craft dipped below the plane of Saturn's ring system. Its imaging system showed few features and on its edge a polar 'hood' was observed. This lack of visual images through the clouds was the main disappointment of the encounter with Titan.

Voyager made up for the lack of visual images of Titan by revealing much information at other, non-visible wavelengths. These data show that Titan's atmosphere is very different from what was previously expected.

Experiments carried out from Earth had shown that Titan's atmosphere contains methane, which gave rise to speculation that the type of chemicals needed for the existence of life might exist there. Voyager's ultra-violet spectrometer showed that Titan's atmosphere is largely molecular nitrogen with single nitrogen atoms and ionised nitrogen. Infra-red and radio wave observations are also consistent with this, which means that Titan's and Earth's atmospheres have the same major constituent. This direct identification of molecular nitrogen in Titan's atmosphere has been described as the most important discovery made by interplanetary spacecraft.

The methane observed from Earth constitutes only about 1% of Titan's atmosphere, and it is believed that the satellite's reddish-brown colouring is due at least in part to small amounts of organic compounds in its atmosphere. Such products could result from photochemical reactions caused by sunlight shining on the atmospheric gas. For example, hydrogen cyanide could be produced, and although this is toxic to man, it could be a step in the formation of many compounds vital to life.

It had been thought that Titan might be fairly warm, heated by a greenhouse effect like Venus, and with its atmosphere it was thought to offer the last hope of finding life in our Solar System. Although Voyager was not specifically designed to look for signs of life, its radio data reveals that Titan is bitterly cold (around 92 K, or −181°C), perhaps with rivers of methane cutting through methane glaciers under a sky of nitrogen, and so puts paid to any real hope of finding life on Titan. Any forms of life which may have existed would be deeply frozen in its surface — a surface scientists would dearly love a chunk of to examine!

Current thinking is that Titan's clouds are made of methane rather than nitrogen, but this is not definite, as it would lead to a difference in temperature measurement of only −4 K, which is probably within the limits of experimental error. The temperature on Titan is very near to the triple point of methane, which means that this substance can exist as a solid, liquid or gas. Methane may therefore play the same role on Titan as water does on Earth — forming rain, snow, ice, glaciers, the seas and atmospheric water vapour; liquid methane rain may be falling on Titan this very moment!

Before the Saturn encounter, Titan was thought to be the largest moon in our Solar System. Voyager's radio experiments have however shown that its diameter is 2560 km (1590 miles), which is slightly smaller than that of Jupiter's moon, Ganymede. Titan is therefore only the second largest satellite in our Solar System — but it is still bigger than the planet Mercury. No one has yet been able to explain why Titan's atmosphere is dense, whereas even Ganymede has no atmosphere.

	Saturn	Titan	Rhea	Dione	Tethys	Enceladus	Mimas
Period of revolution	29.5 years	15.9 days	4.5 days	2.7 days	1.9 days	1.4 days	0.9 days
Radius (km)	60 000	2560	800	550	510	250	175
Distance from Saturn (km)		1 222 600	527 600	377 900	294 200	238 300	185 800

Table 1. Dimensions and periods of revolution of Saturn and its major satellites.

The cratered surface of the moon Mimas taken from a range of 425 000 km. The largest crater is over 100 km in diameter and shows a prominent central peak. The heavy cratering indicates an ancient surface. (JPL).

Other satellites

The other satellites of Saturn are much more like the other moons of the Solar System. They range in size from roughly that of our moon or the four large moons of Jupiter, down to quite small bodies comparable to the moons of Mars. Voyager I's accurate measurements of the satellites' sizes has led to more accurate estimations of their densities, which turn out to be about 1.2 to 1.3 times the density of water and close to that predicted for the nuclei of comets. One unproved theory of their origin is that they were formed from cometary material unconnected with the Saturnian system.

Some of the moons show really large craters: Mimas has one with a diameter of around 100 km, Tethys another some 200 km across (compared with Tethys' radius of 510 km!), and Dione and Rhea have surfaces marked with bright areas as well as the heavily cratered regions. One large feature on Dione may have cracked the satellite's surface to such an extent that the other face has been resurfaced by the impact; certainly this area on the opposite face shows fewer craters. Rhea has a very ancient surface (like Jupiter's Ganymede), and is probably one of the oldest moons in the Solar System — heavily cratered to such an extent that craters are superimposed. Its low gravitational pull has been suggested as the reason why Rhea's craters are much less regular than those of our own moon.

Enceladus is different again from the other medium-sized satellites of Saturn. It shows no cratering, which suggests that some process, possibly Dione's gravitational effects, must have covered up the ancient cratering on its surface. Whereas Voyager I only came within 202 000 km of Enceladus, Voyager II will go much closer, and should therefore increase our knowledge of this unusual satellite.

In 1966 observations from Earth revealed what was apparently another moon of Saturn; it was named Janus. Voyager I has shown that this object is in fact two moons (now known as S10 and S11), which are orbiting Saturn within 50 km of each other at a distance of 2½ times the radius of the planet, just outside the 'F' ring. One of them is a strangely elongated body some 135 km in length by 70 km in width, and scientists feel it is likely these two satellites were once a single object. It has not yet been possible to estimate their masses and densities, but it seems likely they consist of ice.

Conclusions

Voyager I is now speeding away from us and will leave the Solar System without encountering any other major objects. However, it will continue to relay information back to Earth about conditions in space (such as the ions and magnetic fields present) for many years.

As yet only preliminary evaluations of Voyager I's data from both Jupiter and Saturn have been published, but there is no doubt that this project has been an overwhelming success. In the light of this it is alarming that the United States seems set to reduce its interplanetary programme because of lack of funds. Voyager II is on its way to Saturn, Uranus and Neptune, and Project Galileo will hopefully be launched to schedule this time (ETI, October 1980 and March 1981) for a Jupiter encounter. President Carter also promised funds for a further Venus orbiter and probe to map the surface of Venus by radar and test its atmosphere, but with the change in political atmosphere in the US this must now be uncertain. These projects, however, are the last on the drawing board of this type, and since such missions have to be organised around ten years ahead the signs are not hopeful. There is even a possibility that funds for the Deep Space Network ground stations will be cut off, in which case Voyager II could reach Uranus and Neptune without anyone on Earth being able to collect the data!

Whilst acknowledging that space probes and the associated communications links are very expensive, it has been estimated that by the end of its Saturn flyby in August 1981, Voyager II will have cost each American citizen only twenty cents per year. Project Manager Ray Heathcock reckons the completion of the Voyager project would cost each citizen only another eight cents per year; could anyone seriously propose the abandonment of such an important and costly mission at this stage, with the bulk of the costs already incurred?

One big problem affecting all space projects is the development of the Space Shuttle. This offers a cheap way of getting vehicles into space — not only for the commercially unremunerative planetary science work, but also for the highly remunerative communications satellites, etc. However, the Space Shuttle is well behind schedule, and repeated test problems are claiming so much of the available space work funds that little remains for planetary work.

Under the circumstances, I shall be very tempted to make the trip to the Jet Propulsion Laboratory in California for the Voyager II Saturn flyby in August this year. It may be the last chance for such an experience for many years to come. ●

The writer is deeply indebted to Mr Don Bane, Public Information Office of the Jet Propulsion Laboratory, California, for providing excellent photographic artwork of the computer-enhanced images of the Saturn encounter.

Thanks are also due to Ms Kit Weinrichter, NASA, California, for help in many ways, and the Stanford University, California, for information on radio experiments. Without the assistance of these people, this article could never have been written.

Two images of Saturn's eleventh moon seen from a distance of 177 000 km, taken 13 minutes apart. The shadow which has moved across the face is probably due to a small, narrow ring of Saturn. The size of this moon is about 135 x 70 km. (JPL).

Facts from Fluke on low-

cost digital multimeters.

When you're looking for genuine value in a low-cost DMM you have a lot more to consider than price. You need information about ruggedness, reliability and ease of operation. Accuracy is important. And so are special measurement capabilities. But above all, you must consider the source, and that company's reputation for service and support.

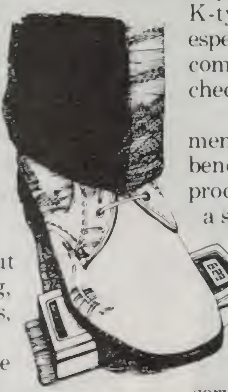
Fact is, as electronics become more a part of our daily lives, dozens of new manufacturers are rushing to market their "new" DMM's. In theory, this is healthy; but in practice, crowding is confusion.

To help you deal with this flood of new products, here are some facts you should know about low-cost DMM's.

	PRODUCT	FUNCTIONS	RANGES	DIGITS	BASIC DC ACCURACY	CONDUCTANCE	OTHER SPECIAL FEATURES
HANDHELD MODELS	8022A	6	24	3½	0.25%		Basic six-function DMM; lowest-priced
	8020A	7	26	3½	0.1%	X	**High accuracy; pioneer in conductance**
	8024A	9	26	3½	0.1%	X	Direct temperature readings; continuity/input level detector with selectable audible signal; peak hold capability.
BENCH PORTABLES	8010A	7	31	3½	0.1%	X	True RMS; extra 10A range.
	8012A	7	31	3½	0.1%	X	True RMS; two extra low resistance ranges.
	8050A	9	39	4½	0.03%	X	True RMS; selectable reference impedances with direct readouts in dBm; offset feature.

The economics of endurance.

Even the least expensive DMM isn't disposable. Accidents happen, and test instruments should be built to take the abuses of life as we live it.



Look for a DMM with a low parts count for reliability, and rugged internal construction protected by a high-impact shell. Make sure the unit meets **severe military tests for shock and vibration.**

Another feature to check out is protection against overloading, whether from unexpected inputs, transients, or human errors.

Just for the record, all Fluke low-cost DMM's meet or exceed military specs, and feature extensive overload protection.

The importance of being honest.

Just because a multimeter is digital doesn't mean it's automatically more *accurate* than a VOM — even though the LCD might give you that impression. The benchmark for accuracy in DMM's is *basic dc accuracy.* The specs will list it as a percentage of the reading for various dc voltage ranges.

Of course accuracy is more critical in some applications than others, and increasing precision and resolution in a DMM usually means increasing price. In the Fluke line, you can choose a model with a basic accuracy of 0.25% (the 8022A), others rated at 0.1%, or the new 8050A bench/portable at 0.03%.

Special measurements: getting more from your DMM.

Actually, for all the variations in size, shape and semantics, most DDM's **perform five basic measurements: ac and dc voltage and current, and resistance. Prices vary according to the number of ranges and functions a DDM delivers.**

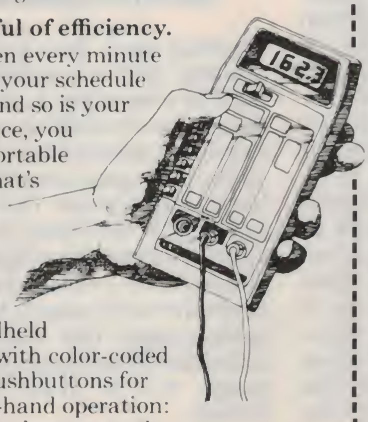
The Fluke line includes DMM's with from 24 to 39 ranges, 3½ and 4½-digit resolution, and some unique functions you won't find in any other DMM. Additional measurement capabilities like temperature, dB, conductance and circuit level detection.

If your work involves temperature measurements, the new 8024A delivers direct temperature readings via any K-type thermocouple. This is especially useful in testing component heat rise and checking refrigeration systems.

Another talented instrument is our new 8050A bench/portable. The microprocessor-based 8050A features a self-calculating dB mode in which dBm readings are displayed automatically referenced to one of 16 selectable impedance ranges — a real timesaver when servicing audio equipment.

And of course no discussion of DMM's is complete without considering conductance — a Fluke exclusive featured on five of our low-cost DMM's — which allows you to make accurate resistance measurements to 100,000 Megohms. You can't do that with any ordinary multimeter, but it's a must for checking leakage in capacitors and measuring transistor gain.

A handful of efficiency.



When every minute matters, your schedule is tight and so is your work space, you need a portable DMM that's fast and easy to operate. We designed our handheld DMM's with color-coded in-line pushbuttons for true one-hand operation: no need to hang onto the meter with one hand while twisting a rotary dial with the other.

But there's more to convenience than fingertip control. The 8024A, for example, is also designed to function as an instant continuity tester, with a selectable audio tone to indicate shorts or opens. It also has a peak hold feature to capture transients.

A word about warranties.

Last but not least, look closely at the company that manufactures a low-cost DMM. Their service is just as important as their product. Look for no-nonsense warranties, a large family of accessories, an established network of service centers and technical experts you can rely on.

That's how you'll recognize a knowledgeable supplier of low-cost DMM's, a company with experience, resources and a commitment to leadership in the industry.

Incidentally, you'll find it all at Fluke.

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Project 1501

Experimental negative ion generator

For those experimenters who just have to find out for themselves what the subject is all about, this negative ion generator should provide a good basis for experiment.

Design: **Jonathan Scott** Development: **Graeme Teesdale**

THE RISE in popularity of negative ion generators, the claims made for them, and the attention they have received in newspapers and magazines recently has undoubtedly intrigued many readers with a technical background or interest, as evidenced by the deluge of letters and phone calls we've received in recent months requesting information and project material to be presented in ETI.

Having read the article presented elsewhere in this issue, undoubtedly many of you will be 'hot to trot' to experiment with an air ioniser but have been daunted by the cost of commercial units. As the electronics associated with a negative ion generator is relatively simple, generally employing readily available components, this article describes how to build a unit that can be used as the basis for experiment. The cost of commercial units, at least in part, is justified by the design and construction of the emitting head, which requires somewhat more specialised parts and construction than are available to the average constructor in order to work efficiently.

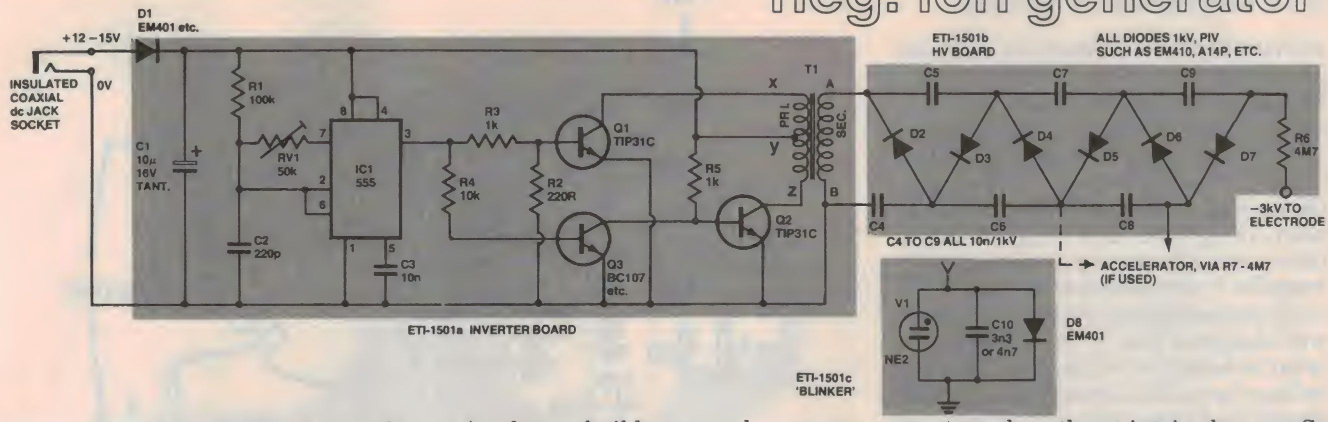
All the present negative ion generator designs that we have examined operate on the 'corona discharge' principle. This requires relatively high voltages — around 2.5 kV to 3 kV. In mains-operated units this is usually obtained by a voltage-multiplier rectifier operated direct from the 240 Vac mains. While this is economical and efficient and, in an assembled plastic box, fairly safe, it is not at all safe for anyone without a great deal of experience to tinker with on the workbench or kitchen table, etc. With this in mind, we have designed our unit to work from a 12 -15 volt supply, employing a dc-to-ac inverter and voltage-multiplier rectifier, giving a relatively safe high tension (HT) voltage to operate the emitting head. This has the added advantage that it is portable and can be used in a car or run by a plug pack from the mains. In addition, we have kept in mind that many of the victims of electrocution each year are people who should have known better. Our project design was partly motivated by the desire to avoid the necessity of having to replace design staff — who are hard to come by, expensive and cannot run the risk of being zapped like the occasional 20¢ transistor! Prime motivation behind the design was to avoid losing readers, though.

Our unit can be powered from 12 Vdc or a plug pack. The blinker testing device is at left.

Circuit design

The negative ion generator electronics can be separated into three components: an oscillator, a driver and step-up transformer comprising the dc-to-ac inverter, and the voltage-multiplier rectifier.

A 555 timer IC (IC1) is arranged as an astable multivibrator. A trimpot is included in one of the timing inputs (pin 7) to allow adjustment of the mark-to-space ratio of the output to ensure equal drive to the two driver transistors, Q1 and Q2. These two transistors alternately switch current through the



primary of transformer T1. As both Q1 and Q2 are NPN transistors, one has to receive an inverted drive signal so that it is off when the other transistor is on and vice versa. Thus Q3 is employed to invert the drive to Q2.

Transformer T1 steps up the drive applied to its primary, providing a 500-600 V peak-to-peak output at the secondary (depending on the supply voltage).

As about 3 kV dc is required to operate the emitter head, a Cockcroft-Walton voltage multiplier circuit is employed, multiplying the secondary voltage of T1 six times. A large value series resistance, together with the inherently poor regulation of the rectifier circuit, ensures that the output short-circuit current is very low to reduce shock hazards.

To enable you to test the operation of this unit a 'blinker' has been provided. This simply consists of two large 'pads' on a piece of pc board with a diode, capacitor and neon connected between them. With the pad to which the diode cathode connects held with your thumb, the other pad acts as an 'antenna' or 'collector' when held in front of the emitter head of any negative ion generator.

As charge builds up on the antenna pad, the capacitor will charge up. When this reaches a voltage that exceeds the breakdown voltage of the neon, the neon will conduct briefly while the capacitor discharges and you will see a flash. The charge will build up again and the whole process will be repeated.

The 'blinker' thus provides a crude measure of the ion production of the generator being tested. The closer the blinker is held to the emitter head, the faster it will flash. Alternatively, if held a fixed distance from the emitter heads of different air ionisers in turn, the one in front of which it blinks fastest will have the greater ion output.

Design of the emitter head

The object of the emitter head is to take in the HT, in our case about 3 kV, and produce a stream of negative ions flowing forwards into the room in which the generator is placed. The ions are produced by a very intense field gradient, which is induced by the high voltage and the geometry of the head assembly. This ion flow is a corona wind. It is a basic principle of electrostatic physics that the field gradient is stronger in the immediate vicinity of a point projection, the gradient being greater when the point is sharper. So most ion generators employ some combination of sharp projections and high voltage. A number of other matters affect the choice of head geometry. Firstly, the design should expel the ion stream away from itself to allow more ions to be emitted. Secondly, it should achieve its aim with a minimum of ozone production. Thirdly, it should employ points made of a hard metal to resist cathode stripping and hold their edge, without being too hard to work or too expensive or exotic to get easily. We will briefly discuss these aims and the relevant principles behind their realisation, then give you a couple of examples to act as a guide for experimentation.

If the point is spaced well away from other parts of the unit the ions will naturally repel themselves away from the region of emission. However, if the point or points are partially enclosed in the case of the device there may need to be either a chimney-shaped assembly around the emitters or some sort of accelerator electrodes to help eject the ions from the emitter head.

Wherever there is ion production there will be ozone production. Ozone, O_3, is a product of higher energy ▶

HOW IT WORKS — ETI 1501

One board contains a dc-to-ac inverter, a second board a high voltage multiplier rectifier and a third a 'blinker' test unit.

The dc-to-ac inverter on board ETI-1501a consists of a 555 astable multivibrator, the output of which is used to drive two transistors operated in push-pull, the collectors of which switch current through each side of the transformer (T1) primary in turn. Diode D1 prevents any damage from a supply connected with reverse polarity. Capacitor C1 is a bypass. IC1 oscillates at around 25 kHz, determined by R1 and C2. The exact frequency is unimportant. The mark-to-space ratio of the output of IC1 (via pin 3) may be adjusted by RV1, which is connected in series with pin 7 of IC1.

The output of IC1 drives the base of Q1 directly, via R3 and R2. Q1 turns on when the output of IC1 goes high. Resistor R3 is there principally to limit the base current supplied to Q1, while R2 serves to discharge the base-emitter junction capacitance so that Q1 turns off quickly when the output of IC3 goes low.

When pin 3 of IC1 goes high, Q3 also turns on, preventing Q2 from turning on. When pin 3 of IC1 goes low, Q1 and Q3 turn off and Q2 will turn on as base bias will be supplied via R5.

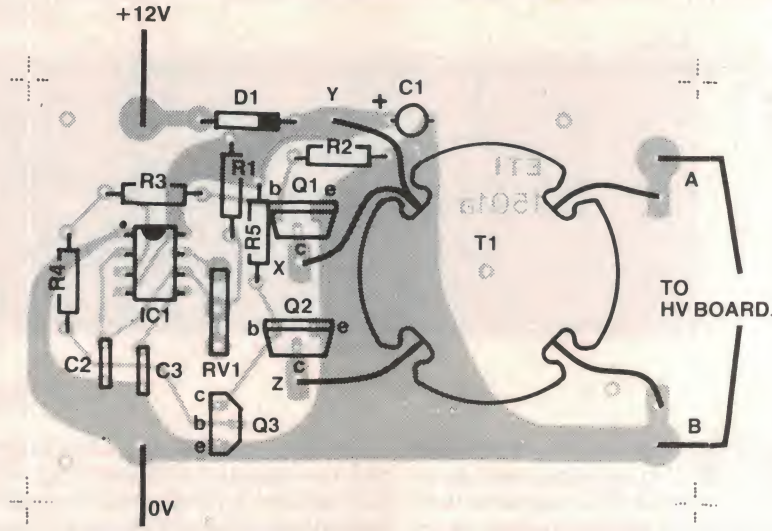
Thus current is alternately switched through each side of the primary of T1. The secondary provides a voltage step-up of 25:1. If the supply voltage is 12 Vdc, then the peak-to-peak output from the secondary of T1 will be 600V. The voltage-multiplier rectifier, on board ETI-1501b, employs the well-known Cockcroft-Walton circuit, where the output of successive half-wave rectifiers is connected in series with the previous one. This circuit provides a multiplication of six times. Thus, with a 12 Vdc supply, the output will be about −3.6 kV. With a 10 Vdc supply (as can be obtained from a 9 Vdc plug pack), about −3 kV is obtained. An output for an 'accelerator' is provided.

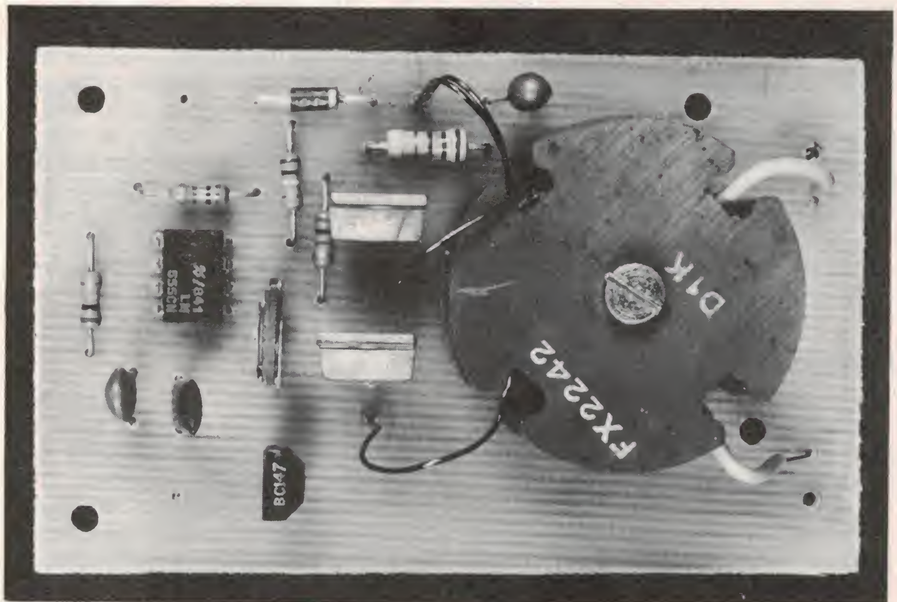
The high voltage output to the emitter head is taken via a 4M7 resistor to ensure that only low short-circuit current occurs if the emitter head is accidentally contacted or excessively humid air causes 'flashover' from the emitter.

The blinker is simply a crude relaxation oscillator. When a charge builds up on the 'antenna' pad, it will charge C10. When the voltage on C10 reaches the breakdown voltage of the neon, V1 (about 70 V), the neon will conduct. This will discharge the capacitor, the voltage across it falling until it reaches the extinguishing voltage of the neon (about 30-40 V), which will then cease conducting. While the neon conducts, it will emit light, but as it discharges C10 fairly rapidly, all you will see is a brief flash from the neon. Diode D8 ensures only negative charges operate the blinker.

When the neon ceases conducting, the charge on C10 will build up again and the whole process will be repeated.

activity than is necessary for more ion production. It is a corrosive as well as a strong antibacterial agent, and is poisonous in sufficient concentration. About 0.025 to 0.05 parts per million (ppm) is recognised as a safe level. Ozone is what you smell after there has been arcing, such as in a motor commutator; an acrid, coppery smell, distinctly metallic. It is produced in some quantity in all ion generators, though some are so well designed that it is negligible. In order to keep it to a minimum, as low a voltage as possible should be used. Our project has been designed to give the lowest voltage compatible with adequate ion production. The design should be such as not to allow any arcing or serious breakdown. This is really only likely if you try using an "accelerator", as there will be no metal in close proximity to the emitter otherwise.



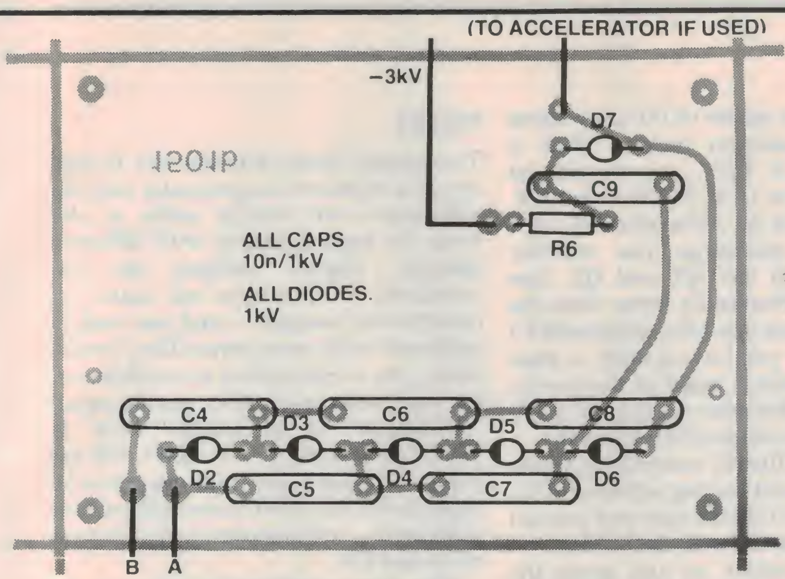

The inverter board, ETI-1501a. Compare this to the overlay above.

The best metal for the points which is easily obtainable is steel, preferably stainless. This is hard enough to hold an edge, and will resist the effects of cathode stripping. The latter is undesirable both because the fine point will be eroded away, and also because the heavy metal ions which are ejected are undesirable agents in the air we breathe (stick to getting your minerals from cornflakes).

Figure 1 shows the emitter head assembly of our prototype. The plastic we used was clear perspex, but this is purely to show you what is inside the gizmo. We recommend some aesthetic colour for your version if you use perspex. There was found to be no need of an accelerator as the points actually protrude beyond the slot in the faceplate. If they are to be recessed an accelerator may be necessary, as the ions soon collect on the plastic parts and build up a field, inhibiting further ionisation or ejection. There is no shock hazard as the unit is not mains powered and there is a very large series resistance between the points and the multiplier output. At most, there results something between a nip and a tickle if you touch the emitter points. The points are steel needles soldered to a brass rod; the needles are probably sharp enough normally, but we struck them against a fine whetstone to sharpen them further. This enhances ion production a little.

Figure 2 shows one commercial unit's layout. It employs an accelerator and points of phosphor-bronze. It has a similar voltage potential to ours, but is physically smaller, due to custom plastic components. The points are


The high voltage board, ETI-1501b. Compare this to the overlay above right.



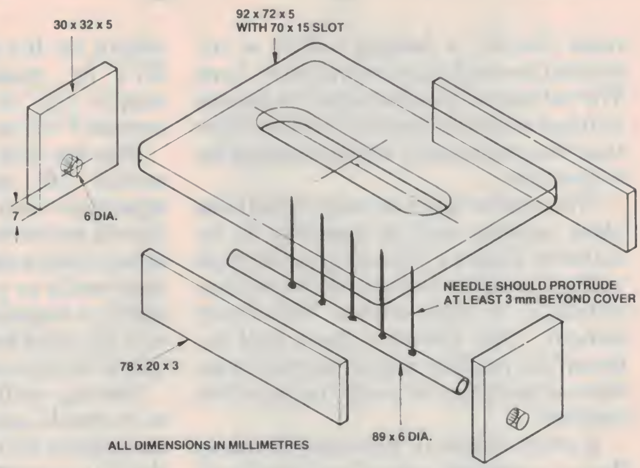


Figure 1. **Exploded view of our emitter head assembly. We used 5 mm and 3 mm thick perspex, but it could all be made from 5 mm perspex. The two pictures below show the completed head. Brass tubing supports the needles, which are soldered to it.**

partially recessed. This unit derives the HT directly from the mains.

Perspex for the emitter head may be obtained from plastics suppliers, such as Cadillac Plastics (where we bought our piece) and you'll find them listed in the Yellow Pages of the telephone directory. We used a piece with a thickness of 5 mm.

ETI-1501 NEGATIVE ION GENERATOR

Resistors .... all ½W, 5%

R1	100k
R2	220R
R3, R5	1k
R4	10k
R6, R7	4M7
RV1	50k

Capacitors

C1	10u/16 V tantalum
C2	220p ceramic
C3	10n greencap
C4 to C9	10n/1kV ceramic
C10	3n3 or 4n7 greencap

Semiconductors

D1, D8	EM401 or similar
D2 to D7	A14P, EM410, BYX80 or sim. 1 kV PIV diodes.
IC1	NE555
Q1, Q2	TIP31C
Q3	BC547, BC107 etc

Miscellaneous

Three pc boards — ETI-1501a, b and c; T1 — FX2242 potcore and former; coaxial dc jack socket; 9 V 200 mA or 300 mA plug pack (if required); V1 — NE2 70 V neon; piece of perspex about 100 x 100 mm, 5 mm thick; five needles; about 80 - 100 mm of 6 mm diameter thin-walled brass tubing; Horwood case type 34/7/DS; nuts, bolts etc.

Price estimate

We estimate that the cost of purchasing all the components for this project will be in the range:

$35 - $42

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.

Suitable steel needles can be obtained from your family sewing drawer! Failing that, any sewing accessories supplier can help you.

The brass tubing you'll find in hobby and toy stores. The thin-walled variety is best, as it is easy to solder to and easy to cut. We used a piece measuring 6 mm outside diameter.

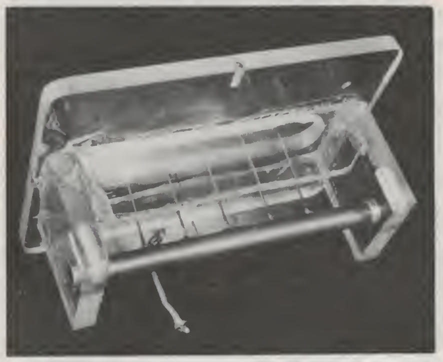
Construction

The ioniser electronics are contained on two circuit boards — designated ETI-1501a and ETI-1501b respectively. The first contains oscillator, driver and transformer, while the second contains the high voltage rectifier. We housed both of these in a small Horwood extruded box, type 34/7/DS, the emitter head being designed to fit in one end.

First stage of construction is to assemble the components on the pc boards. Commence with the 'a' (inverter) board. Insert the resistors, capacitors, IC and transistors before assembling the transformer to it. As usual, take care with the orientation of the diode, IC1 and the transistors. Next, wind the transformer — details are given in the box on page 34. The transformer employs a potcore and this can be held on to the pc board with a nylon bolt — do not use a metal bolt. Cut the transformer coil wires to length, scrape off the insulation and solder them in place. The TIP31C transistors, Q1 and Q2, do not actually require any heatsink, though they do get warm in operation.

The high voltage board ('b') may be assembled next. Take care with the orientation of the diodes. Stand the capacitors erect on the board so that they do not touch each other or you may have arc-over problems between these components.

Mount the appropriate components on the 'blinker' board ('c') next, as you'll ▶



Rear view of our emitter head, showing general construction of the perspex 'chimney' and assembly supporting the needles.

Front view of our emitter head, showing the slot and positioning of the needles. Note that the needles protrude about 3 mm beyond the front face.

Figure 2. **Picture of a commercial air ioniser's emitter head, showing construction.**

need this for a testing aid. It is important to watch the diode polarity here. The cathode of the diode goes to the pad marked with the 'ground' symbol. Note that the components are mounted on the *copper* side.

The emitter head is constructed from clear perspex and its assembly is detailed in Figure 1. We mounted our high voltage board on the rear of the emitter, gluing it in place with a little epoxy cement. This allows a short lead between the rectifier output and the brass tube supporting the needle points of the emitter.

A short length of figure-eight mains flex or a twisted pair of well-insulated hookup cable links the rectifier input (A and B) to the inverter board. This board we mounted on the end plate of the Horwood box using four nuts and bolts and short spacers.

The dc input socket we mounted on one side of the box, as can be seen from the photographs. Exactly how the dc coaxial jack socket is wired will depend on how your plug pack output plug is wired. Some have the outer connector connected to positive, while others have it connected to the negative. Watch the wiring of this socket if you plan to operate your unit in a vehicle. The outer connector is electrically connected to the socket's mounting and this automatically connects the case to that side of the supply. If your plug pack has the outer of its dc connector connected to positive then you will not be able to operate your ioniser project in a vehicle that has the battery negative connected to the vehicle chassis, without running the risk of shorting the supply if the ioniser's case comes in contact with vehicle ground.

With everything assembled, you can proceed to test it.

Getting it going

You will need a multimeter and a supply of between 9 Vdc and 14 Vdc. It would be handy, but not essential, to have a high voltage probe for your multimeter, having an impedance of 10M or more.

If you do not have a high voltage range on your multimeter to enable you to measure voltages greater than 3 kV, switch it to the current range to read 300 mA full scale or more, and connect it in series with the dc supply input.

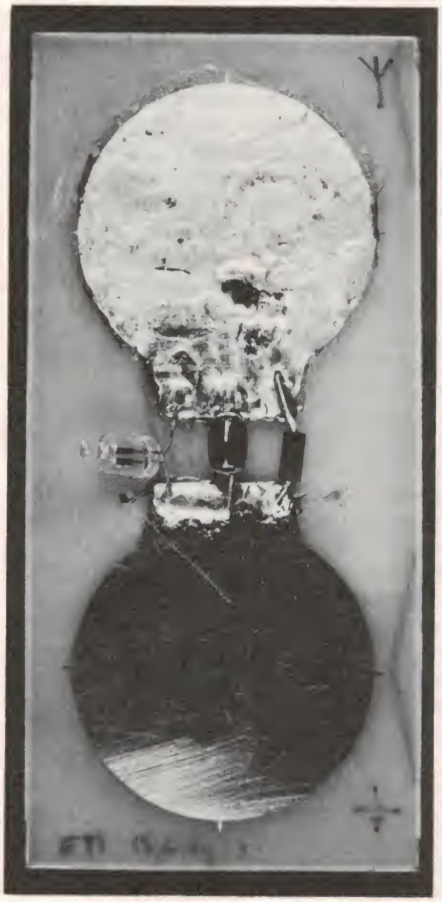
Switch the supply on and, assuming all is well, adjust RV1 on the inverter board for *minimum* current. This could be between about 220-280 mA.

Alternatively, measure the rectifier output (at the anode of D7) and adjust RV1 for *maximum* output. With a supply rail of 10 V, you should get around 3 kV; at 14 V, a little over 4 kV.

Run the unit for a few minutes, then switch off, discharge the rectifier capacitors and feel Q1 and Q2. One should not be markedly hotter than the other, otherwise you have adjusted RV1 incorrectly or you have a fault — most likely a transistor inserted incorrectly or a dry joint between the output of IC1 (pin 3) and the bases of Q1, Q2 or Q3.

Having confirmed everything works as it should, and having adjusted RV1, assemble it all into the case and you can check its operation with the blinker.

Turn the ioniser on and grasp the blinker so that your thumb is in good contact with the pad marked by the 'ground' symbol. Hold the blinker such that the 'antenna' pad is about 10 mm in front of the emitter. You should be able to count around one blink per second if all is well and this is a good 'bench mark' for successful operation when you experiment with different head designs and geometries.



Our 'blinker'. Components are positioned as per the circuit diagram on page 31. Cathode of D8 is at the bottom.

Notes

This project shows but one way to construct a negative ion generator and the electronics can readily serve as the basis for experimenting with different designs. Higher voltages are unnecessary — and are not usual in commercial designs — and can lead to problems with ozone generation, breakdown, etc. A connection is available on the high voltage board for supplying an 'accelerator' on an emitter head. It should be connected via a 4M7, ½W resistor. The accelerator voltage could be tapped off lower down the rectifier chain if desired — we suggest at the junction of C6 and C8.

The high voltage board may be mounted separate to the emitter head and four bolt-hole positions are provided on the board.

The exact value of capacitors C4 to C9 on the high voltage board is not important and may be any value between about 1n and 22n or so, but should not be lower than 1n. The voltage rating of these capacitors should not be less than 1000 volts.

The dc supply should not be greater than 15 volts, otherwise insulation breakdown within the transformer may be experienced. Likewise, more turns should not be wound on the secondary of T1 or you may experience insulation breakdown. ●

ETI-1501 WINDING DETAILS FOR TRANSFORMER T1

Potcore: FX2242
Secondary: 125 turns of 0.2 mm dia. enamelled copper wire.
Primary: 10 turns, centre-tapped, of 1.0 mm dia. enamelled copper wire.

The secondary is wound on the potcore bobbin first. Wind it in five or six neat layers. Slip thin plastic spaghetti over the start and finish leads so that the spaghetti is held well inside the bobbin. As you finish winding each layer, insulate it with 1 mm mylar sticky tape (if you can obtain it) or electrical insulation tape (a bit heavy, but it will do the job). Wind the next layer on the insulation of the previous layer, etc, until you finish the winding. Wind several layers of insulation over the completed secondary. Leave the start and finish wires protruding from different sides of the bobbin so that they exit via different slots of the assembled potcore.

Wind the primary over the secondary; it can be wound bifilar (two wires together, five turns, connect finish of one to start of other to provide centre tap) or in one winding — but don't forget the centre tap. Wind the primary so that its wires exit the potcore opposite the secondary wires.

In operation, if you have breakdown problems (arcing sounds inside the potcore) it means you have not wound or insulated your secondary carefully enough and you'll have to rewind the transformer.

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NEW

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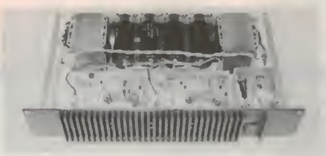

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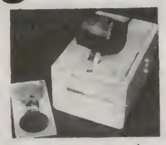

There's been a lot of talk and a lot of research into the effects of negative ions. Find out whether they're as beneficial as some people say—at this price you can afford to experiment. Commercial units sell for up to $100. ETI design (see March 1981).

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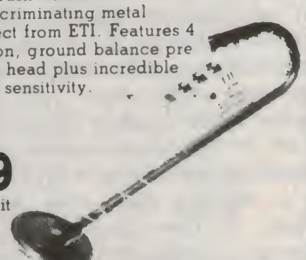

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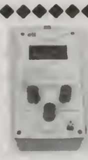

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Happy 10th Birthday ETI!

Project 567

A portable electronic core-balance relay

Design: **Jonathan Scott** Development: **Graeme Teesdale**

Mains-operated equipment that goes faulty is potentially lethal. Electro-mechanical 'core-balance relays' which sense earth-fault currents and trip a circuit breaker have been available for house-mains installation for some years. Portable core-balance relay units have obvious advantages. Protect yourself — and your equipment — with this simple, inexpensive project.

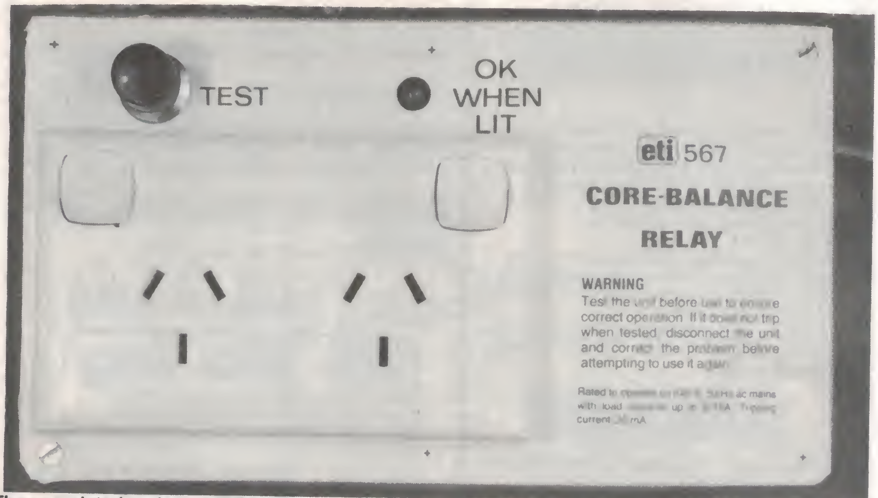
A FAULT in mains-operated equipment can place any external metal parts at mains potential — if you then happen to complete a path between the equipment and earth, you'll get a nasty surprise at the least or become another victim in the electrocution statistics. In some circumstances a fault may create a leakage path that permits a current to flow through flammable material — with obviously dangerous consequences. A suitable protection device that can sense such fault conditions can prevent possible disaster.

Also, when servicing mains-operated equipment — particularly such things as light sequencers, dimmers, etc — it is often necessary to work around lethal mains voltages. A device that trips a circuit breaker or relay should you accidentally touch live mains wiring is clearly good for your health!

Every hobbyist or serviceman should have such a device.

When a fault current finds a path to earth in mains-operated equipment the currents flowing in the active and neutral lines are found to be different. This fact can be put to use to sense 'earth faults', as they are called, and trip an isolating relay or circuit breaker. Such a sensing device is referred to as a 'current operated' or 'core-balance' earth-leakage device.

We have designed a portable electronic core-balance relay that can be set to sense earth-leakage currents as low as a milliamp or so, or a maximum of about 25 mA. It is designed to operate on 240 V, 50 Hz ac mains and with rated load currents up to 5 A or 10 A, depending on the relay used. Once tripped, the unit can only be reset by turning off the mains and removing the faulty load.



The completed project. Our Scotchcal panel is essential — see page 67 for suppliers.

Australian Standard

The Australian Standard relating to core-balance relays is AS3190-1980, titled "Approval and Test Specification for Current-Operated (Core-Balance) Earth-Leakage Devices". It is published by the Standards Association of Australia, Standards House, 80 Arthur St, North Sydney NSW.

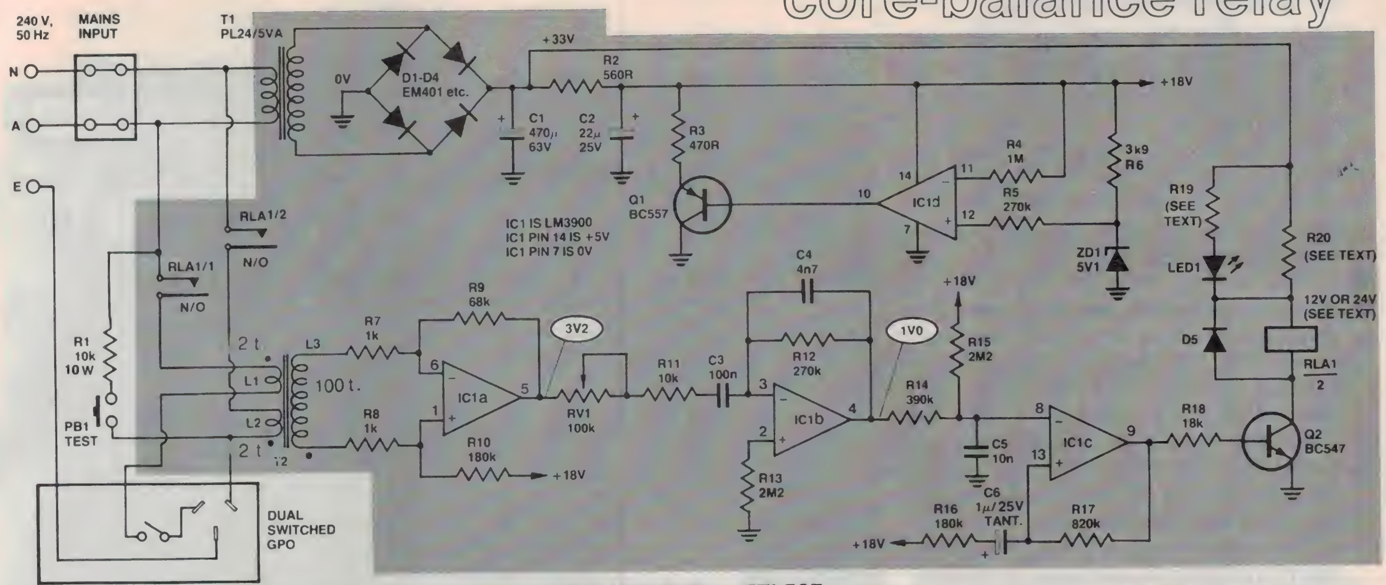
The Standard requires the unit's ratings to be marked on the front panel along with a warning notice. These have been included on our front panel artwork. In addition, the Standard requires any portable device to be double insulated (as per AS C100) between the external surface of the enclosing case and any wiring and component which does not form part of the protected circuit, and the enclosing case to be double insulated from any earth conductor incorporated in the device. Therefore we chose to construct our unit in a plastic case, using nylon bolts to secure the internal components. The Standard also requires that the flexible cord should be of a type not inferior to a heavy duty sheathed type (see AS 3191), correctly wired (as per AS C100) and have a free length of not less than 1.8 metres.

So far as we are aware, our prototype conforms to the construction requirements of AS 3190-1980.

Construction

It would be best to commence construction by marking out and drilling the plastic case. We used a BIM Box, No. 2006-16-ABS, measuring 190 mm long by 111 mm wide by 60 mm high. These are imported and distributed by Crusader Electronics of Sydney. We bought ours at Radio Despatch Service. However, several similar all-plastic 'jiffy'-style boxes are available and you should have little difficulty getting one to suit.

The mains input cable should be secured with a clamp grommet, the leads



HOW IT WORKS — ETI 567

The circuit can be divided into three parts: the unbalance current sensor (T2), the trip circuit, and the power supply. We'll examine each in turn.

TRANSFORMER T2

This senses the unbalance current that occurs with an earth-leakage fault between the active line and earth. The two primary windings, L1 and L2, are bifilar wound (parallel wires, wound in the same direction). Primary L1 is connected in the active line, between the mains input and the output to the load. Primary L2 is connected in series with the neutral line, between the mains input and the output to the load. The two primaries are connected such that the load current through L1 flows in the opposite direction to the load current through L2. Thus the currents are in phase opposition, and if no earth fault is present, will be equal and there will be no output from the secondary of T2 (L3). The spots adjacent to the end of each winding on the circuit diagram indicate the phasing of each winding, showing that L1 and L2 are oppositely phased.

If an earth fault occurs, more current will flow in the active line than the neutral line. Thus, the currents through L1 and L2 will be different, or unbalanced, and an output will appear from the secondary. This output serves as an input for the trip circuitry.

THE TRIP CIRCUIT

We shall have to describe the operation of this circuit 'back to front' in order to make its operation clear. The trip circuit involves three op-amps from IC1 — IC1a, b and c — plus Q2, RLA1 and associated components. IC1 is a quad op-amp, type LM3900.

When power is first applied, capacitors C5 and C6 will first appear as a low impedance (virtually a short circuit) as they are not charged. Thus, C5 will hold the inverting input of IC1c (pin 8) at 0 V and C6 allows a current to flow into the non-inverting input (pin 13) via R16. These two initial conditions will cause the output of IC1c (pin 9) to rise rapidly towards the positive supply rail. Positive feedback via R17 ensures that this op-amp will latch in that condition. When pin 9 of IC1c goes high, base current will flow in Q2 via R18, and Q2 will turn on. When Q2 turns on, collector current will be supplied via the relay and LED indicator circuits, the relay will operate and the LED will light.

When the relay operates (on switch-on) the two relay contacts, RLA1/1 and RLA1/2, close and apply power to the output socket.

A short period after switch-on, C6 will be charged and dc feedback via R17 will hold the output (pin 9) of IC1c high.

When an earth fault occurs, an output voltage will appear across the secondary (L3) of T2. This will be amplified by op-amp IC1a, the output of which (pin 5) drives the input of an active filter involving IC1b, via RV1, R11 and C3. RV1 acts as a sensitivity control, as it is in series with the input of IC1b, the gain of which (at 50 Hz) is determined by the ratio of R12 to RV1+R11.

Op-amp IC1b is arranged as a simple active low-pass filter, having a cutoff of around 130 Hz. This gets rid of high frequency noise spikes passed on from the mains via T2. Any noise transmitted down the mains will not be in phase on the active and neutral lines.

The first positive-going pulse, resulting from the mains earth fault, appearing at the output of IC1b (pin 4) will be applied to the inverting input of IC1c via R14. Now, IC1c will be latched with its output high. When the 'fault' signal appears the output of IC1c will be driven low, removing base current from Q2, which will turn off, causing the relay to drop out and the LED to extinguish. When the relay drops out, its contacts remove power from the output socket.

IC1c will latch into the 'output low' condition as dc feedback via R17 will hold the non-inverting input low.

The CR network R14-C5 helps prevent noise on the mains causing false triggering and only delays the operation of the trip circuit less than 10 milliseconds. The trip circuit will operate no more than about half a cycle after the fault signal occurs, at maximum, and the relay takes about 15 ms to open. Thus, maximum delay is about 35 ms, well under the 50 ms required in AS3190-1980.

POWER SUPPLY

Power supply for the electronics is derived via a small pc-mount transformer, T1. This is a 240 V to 24 V type, rated at 5VA or 7VA. A bridge rectifier is employed, using diodes D1 to D4, feeding a capacitor-input filter consisting of C1, R2 and C2. The nominal output voltage across C1 is about 33 volts. This is used to supply the relay driver (Q2), relay and LED indicator circuits.

A simple shunt regulator is used to derive an 18 volt supply for the trip circuit. IC1d forms a voltage-controlled current source, its output driving the shunt regulator transistor Q1. The emitter-collector current of Q1 flows from the positive supply rail to the 0 V rail via R3. The shunting current via Q1 produces a voltage across C2 of 18 volts, the shunting current being determined by the 5V1 zener diode at the input of IC1d. If the rectifier output voltage attempts to rise, the shunting current via Q1 will rise and the voltage drop across R2 will increase. The opposite occurs if the rectifier output decreases.

This type of supply was chosen for its good noise pulse rejection characteristics.

TEST CIRCUIT

A 10k, 10 W resistor is connected via a momentary-action pushbutton from the neutral line of the output socket to the relay (input) side of the active line. When the pushbutton is operated, a current of about 24-25 mA will flow in L2, but not in L1. This simulates a fault condition and the electronics will trip the relay, removing power from the output. IC1c will latch in the 'output low' condition and the unit can only be reset by removing the mains input for a short period.

being terminated to a six-way plastic terminal strip. We used a Scotchcal front panel (plastic variety, *not* the aluminium type). These should be available from a number of suppliers; see Shoparound in this issue. After drilling the case front panel, the Scotchcal panel should be attached, taking care to smooth out any air bubbles, before mounting the power output socket, pushbutton and LED indicator.

The blank pc board can be used as a template to mark the positions of the mounting holes for drilling in the bottom of the case. Watch the orientation of the board.

The mains cable may be attached and terminated to the terminal strip, and the wires between the terminal strip and output socket may also be installed ▶

at this stage. Note that the 10k, 5W resistor is mounted off the six-way terminal strip, and this can be installed at this time too.

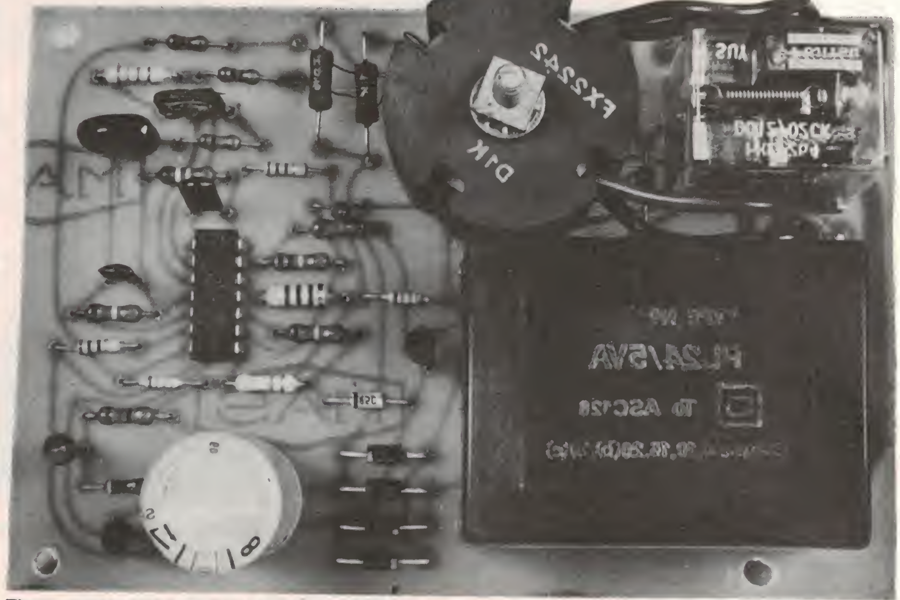
The printed circuit board should be drilled next, if you haven't got one that's pre-drilled. Locate the positions of the mounting holes for the potcore and the power transformer first.

The potcore requires just a single hole, around 4.5 - 5 mm diameter. The power transformer requires three holes. There are two locating pegs that protrude beneath the transformer and holes for these should be drilled about 3.5 - 4 mm diameter. A hole for a securing screw is located between the ac input terminals. This should be drilled about 3 mm diameter.

The relay is soldered direct to the pc board and holes for the pins will have to be drilled, their size depending on the particular relay you're using. We have made the pc board pads large enough to accommodate a variety of relays available. Some, such as the Fujitsu type FRL264, can be obtained with pc mount pins and only a 1.5 mm hole is required for each pin. Others, such as the DEC type MC2U, have flat pins requiring a row of small holes to be drilled in each pad and a slot cut.

The pc board may be assembled next. Mount all the minor components first, taking care with the orientation of the LM3900, the diodes, the two transistors, the electrolytic and two tantalum capacitors. You can leave R7 and R8, which mount adjacent to the potcore, until the potcore is mounted and wired in, as we have done, or pass the secondary leads from the potcore over R7 and R8. Don't forget D5, which mounts between the potcore and the relay — it's difficult to see in the photograph of the pc board, but the overlay should make its location clear.

The potcore should be wound next — see the accompanying box for the winding details. Once you've wound the bobbin, assemble the two potcore halves over the bobbin as indicated in the drawing accompanying the winding details and set the assembly aside for a few moments. You will need a suitable bolt to secure the potcore to the pc board; we used a 4 mm by 35 mm pan head with nut, plus a flat washer and a star washer. Pass the bolt through the appropriate hole in the pc board, from the copper side. Place the potcore assembly over the bolt and secure it with the nut. Use the flat washer against the potcore and the star washer between it and the nut. Terminate the primary and secondary windings to the pc board as indicated on the overlay.



The completed pc board. Assembly is fairly straightforward.

The relay and power transformer may be mounted next. The transformer is secured with a screw which goes between the ac input terminals, as mentioned previously.

Once you have the pc board assembled, check everything carefully — in fact, *double* check. Once you're satisfied all is well, it can be mounted in the box and wired in place. Before mounting the board in the box, attach leads about 150 mm long for the indicator LED (colour code them so you know which is the anode and which is the cathode). Also attach leads for the mains input and output wiring. Use colour-coded 32 x 0.2 mm 240 Vac rated plastic insulated wire for this — red for active, black for neutral. These leads will need to be about 100-120 mm long.

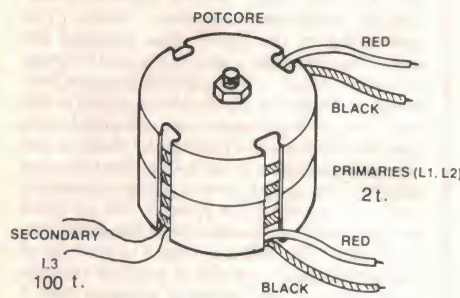
Mount the board in the bottom of the box using nylon nuts and bolts. Raise the board about 5-6 mm off the bottom of the box using fibre spacers.

Wire the ac input and output leads to the six-way terminal block according to the wiring diagram. Once this is done check all your wiring thoroughly, and you're ready for testing.

Test and setup

First thing to do is a series of safety checks before the unit is plugged into the mains. For this you will need a multimeter and a neon test screwdriver. Also, if you can possibly obtain it (beg, borrow or steal ... er, scrounge), a "megger" insulation tester with a rated output of 500 V.

With your ohmmeter on the highest resistance range, measure between the earth and active and neutral pins in turn on the mains input plug. It should read open circuit. Then do the same on the rear of the output socket.

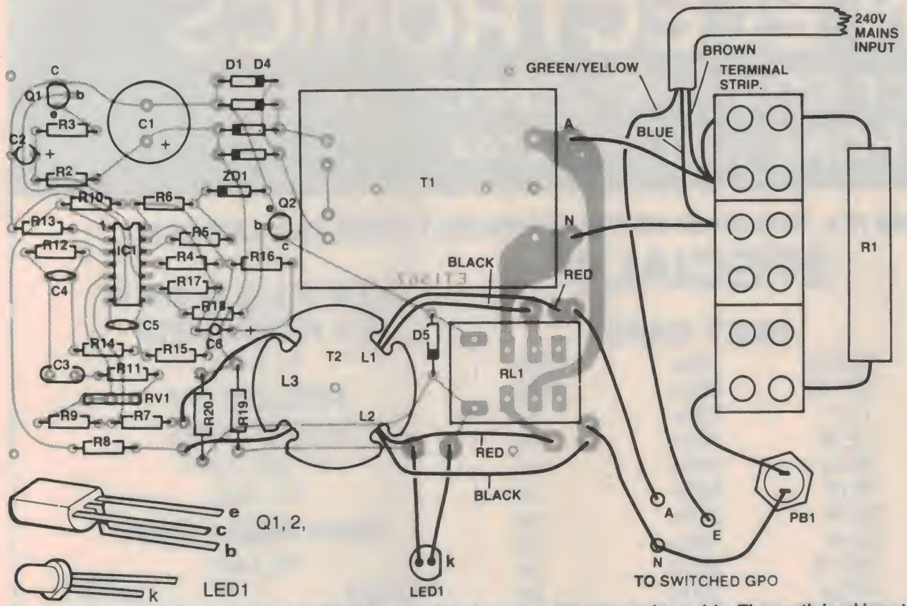


TRANSFORMER T1, WINDING DETAILS

Core: FX2242 36 mm dia. potcore; two halves with bobbin.

Wire: 0.2 mm dia., enamelled copper wire — eight or nine metres will be required; two 300 mm lengths of 32 x 0.2 mm plastic-coated (240 Vac insulation) hookup wire — one red, one black.

Wind the secondary, L3, first, using the 0.2 mm enamelled wire. This may be jumble wound on the bobbin. Put two layers of electrical insulation tape over the finished winding. To wind the two primaries, L1 and L2, lay the red and black insulated wires side by side, place them on the bobbin and wind one turn, followed by almost another turn — such that the start and finish ends come out of adjacent potcore slots. The photograph of the pc board makes this clear, as should the accompanying drawing. Leave about 50-60 mm of lead on each winding for terminating to the pc board.



Component overlay and wiring diagram. Use a clamp grommet for the mains cable. The earth lead input must be the longest of the input leads. Take care with the mains wiring.

Now switch your ohmmeter to a low resistance range (to measure less than 1000 ohms on the scale). Measure between the active and neutral pins on the mains input plug. Your meter should read somewhere between 750 and 800 ohms. This is the resistance of the primary of T1. Do the same on the rear of the output socket. It should read open circuit. Then, manually operate the relay (or connect an external battery or power supply across the relay's coil) and measure across the active and neutral connections on the rear of the output socket. You should measure the resistance of T1's primary again (750-800 ohms).

With the relay operated, check for continuity between the active pin on the mains input plug and the active connection on the output socket. Do the same for neutral line. While you have the relay operated, switch your ohmmeter to the highest range and check for open circuit between the neutral line and earth and the active line and earth.

If you have a megger, you can repeat all the active and neutral to earth checks. Resistance indicated should not be less than 1M. If you then bond all three pins of the input plug together and connect to one terminal of the megger and apply the other terminal of the megger via a flying lead to some part of the case, you should obtain a reading no lower than 10M.

If there are any problems during these tests, sort them out before continuing. If all is well following these tests, you can proceed to test the unit with mains input and set up the trip current.

Set the wiper of the trimpot RV1 to maximum resistance. For the setup test, nothing should be plugged into the output sockets. Plug the unit in and turn it on. The relay should operate immediately and the LED should light. If this does not happen, switch off straightaway, unplug the mains cord and check for wiring or assembly errors. If the LED doesn't light but the relay operates, you've either got the LED connected the wrong way round or R19 is incorrect.

If all is well at this stage, depress the TEST button (the relay should not drop out) and adjust RV1 until the relay just drops out. The LED should go out. Use an insulated handle screwdriver to do this, for safety's sake. Release the TEST button when the relay drops out and turn off the mains input. Wait a few seconds and turn the mains input on again. The relay should operate and the LED should light again. Press the test button again and the relay should drop out, the LED going out also.

Next, reset the unit, plug it in and switch on. Using your neon test screwdriver, check that the active pins on the output sockets are correct. With the earth pin facing you, the active pin should be the upper left hand one. If you find it to be different, switch off and unplug the unit, then test your wall socket to see if it's correct. It is important that the core-balance relay is correctly wired, so that the unit will preserve the active/neutral orientation of the power point with which it is used.

That's it, unless you want to test the unit at ±10% of mains input voltage, etc — the ETI-146 Mainsmaster (Nov. 1979) would come in handy here.

Trip current variation

If you would prefer the trip current to be lower, change the value of R1 and set up the unit as previously explained. For a 10 mA maximum trip current, a 27k, 3W or 5W resistor should be used for R1.

The maximum trip current, according to AS3190-1980, is 30 mA, so it would be wise to keep it below that value by at least 10%, and that's what we have done with the design presented here. ●

ETI-567 CORE BALANCE RELAY PROTECTOR

Resistors	all ½W, 5% unless noted
R1	10k, 10 W
R2	560R
R3	470R
R4	1M
R5, R12	270k
R6	3k9
R7, R8	1k
R9	68k
R10, R16	180k
R11	10k
R13	2M2
R14	390k
R15	2M2
R17	820k
R18	18k
R19	1k (12 V relay) or 330R/1 W (24 V relay)
R20	330R/1 W (12 V relay) or 150R/1 W (24 V relay)
RV1	100k

Capacitors	
C1	470u/63 V electro.
C2	22u/25 V tantalum
C3	100n greencap
C4	4n7 greencap
C5	10n greencap
C6	1u/25 V tantalum

Semiconductors	
D1 to D5	1N4004, EM401 etc.
ZD1	5V1, 400 mW zener
IC1	LM3900
Q1	BC557, BC177
Q2	BC547, BC107
LED1	TIL220R or similar

Transformers	
T1	PL24/5VA Ferguson transformer or sim.
T2	FX2242 pot core

Miscellaneous
ETI-567 pc board; PB1 — 230 Vac rated momentary push button (push-on); plastic case to suit; relay (RL1) Fujitsu D024/02CK (24 V) or D012/02CK (12 V); wire, nuts, bolts etc; terminal block; 2m of 10 A rated mains lead.

Price estimate **$42 - $48**

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.

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220 uf	6.3v	6c
68 uf	6.3v	4c
47 uf	250v	30c
47 uf	25v	6c
22 uf	25v	6c
10 uf	63v	6c
10 uf	25v	6c
2.2 uf	63v	6c
0.47 uf	63v	6c

POLY CAPS

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.047 uf	630v	10c
.1 uf	100v	5c
.12 uf	100v	5c
.33 uf	100v	5c
18 nf	250v	5c
33 nf	250v	5c
68 nf	100v	5c
220 nf	250v	5c
.47 uf	100v	8c
1.2 uf	100v	10c

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496	1.60	403	1.20	930	.55	1674	.70	23 A		1339	7.30	7069	4.45
545	1.90	454	.50	945	.70	1675	.70	30		1342	5.45	7120	1.80
561	.75	460	.55	1014	1.65	1678	2.35	33 F	1.40	1366 W	7.50	7204	4.85
562	.75	495	1.60	1018	3.18	1685	.75	34 E	1.25	LA 3301	6.95	7222	6.25
564	1.40	496	1.90	1047	.75	1687	.95	40		4031	7.05	7310	3.15
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525	1.45	776	9.40	1312	.90	2SD 187	1.35			1020	11.50		
536	3.85	781	6.50	1318 R	.90	200	6.30	AN 214	5.25	1156	4.85		
544	1.10	784	.90	1327	.70	235	2.25	315	7.95	UPD 858	10.95		
555	15.00	785	.85	1345	1.65	261	.95	612	5.10	861	19.75		
681	9.80	799	6.25	1359	.90	288	2.00	BA 301	4.95	SL 1626	11.50		
2SC 103	2.10	815	.90	1383	1.30	313	1.80	511	9.25	1640	8.80		
372	.70	828	.90	1384	1.05	325	1.60	521	9.25	TA 7045	5.75		
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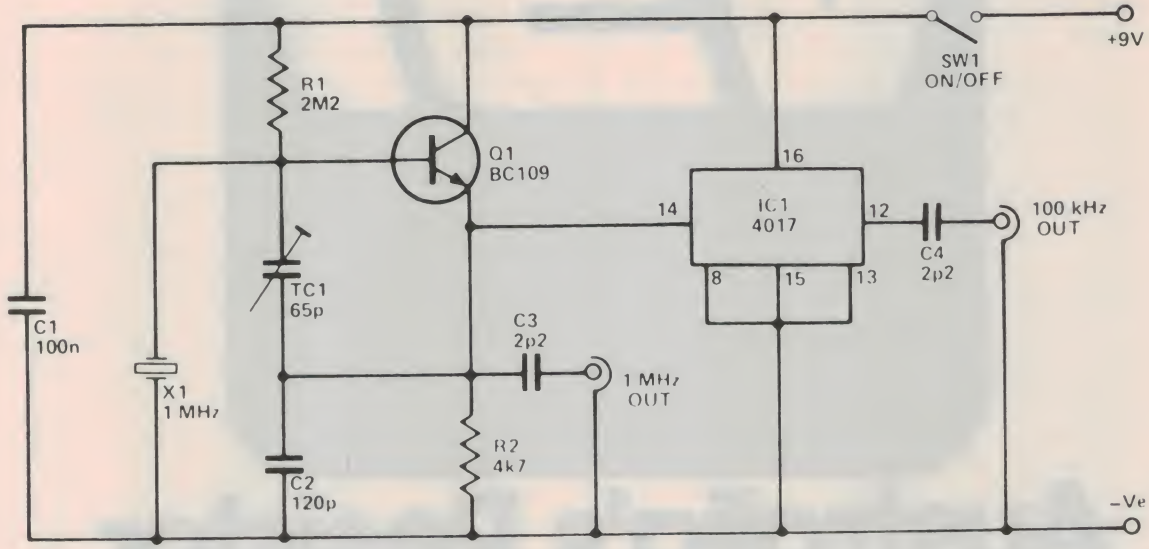
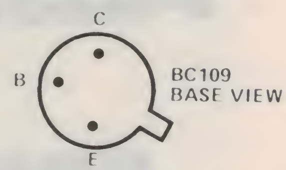
Crystal calibrator for shortwave





A PROBLEM with home-constructed shortwave receivers is that of providing the finished unit with an accurately calibrated tuning dial. A crystal calibrator solves this problem by providing numerous calibration signals that enable the various dial frequencies to be marked on with good accuracy.

A crystal calibrator is also useful for checking the calibration of a shortwave receiver that has been in use for some time.

The calibrator circuit shown here has fundamental outputs at 1 MHz and 100 kHz. However, it does not merely provide calibration signals at these frequencies, but also at harmonics of these frequencies. Harmonics are merely multiples of the fundamental frequencies.

The 1 MHz output therefore provides calibration signals at 2 MHz, 3 MHz, 4 MHz, etc., while the 100 kHz output provides signals at 200 kHz, 300 kHz, 400 kHz, etc. These additional frequencies are produced because the circuit is designed to give an output signal that is not a sinewave, but instead has a very rapid risetime and is virtually a squarewave. This gives a signal which is rich in harmonics at frequencies up to many megahertz.

This circuit provides harmonics that are readily detectable up to 30 MHz (the upper limit of the shortwave spectrum) on any reasonably sensitive receiver.

The circuit

Q1 is used in a simple 1 MHz Colpitts crystal oscillator with output taken from the emitter, loosely coupled via C3 (2p2). TC1 and C2 effectively form a tap on the crystal which acts as a parallel tuned circuit. The output of Q1 is coupled into this tapping, and this gives the positive feedback path needed to produce oscillation. The circuit oscillates at the resonant frequency of the crystal since there is only an efficient feedback path at this frequency via the crystal. There is a voltage step-up action due to the very high Q of the crystal which ensures that there is sufficient feedback to produce strong oscillation and an output rich in harmonics. A crystal is used in the unit rather than an ordinary L-C tuned circuit as a crystal gives better accuracy and stability.

The 100 kHz output is obtained merely by feeding the 1 MHz signal to a CMOS 4017 divide by ten circuit.

TC1 must be adjusted to give optimum accuracy from the unit, and this is easily achieved by connecting a short lead to the 1 MHz output and placing it near to a receiver tuned to either VNG (Lyndhurst, Victoria) on 12 MHz or WWV/WWVH on 10 MHz or 15 MHz. This will produce a low frequency beat note (heard either as a whistle or as a cyclic rise and fall in the volume of the station), and TC1 is simply adjusted for the lowest attainable beat note. A beat rate of well under one per second should be easily obtained.

Construction

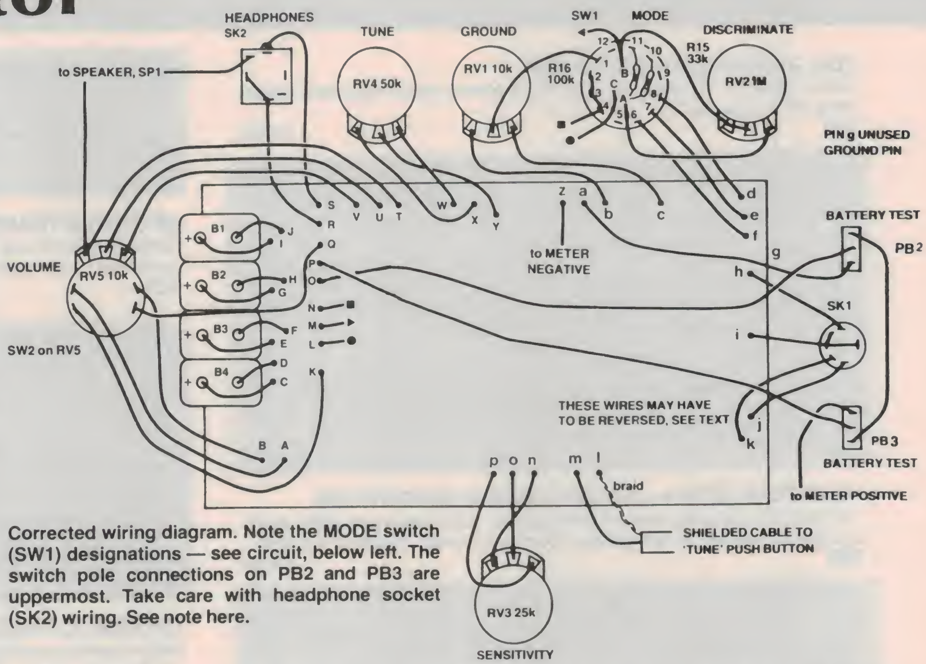
Construction is generally non-critical. However, C1 should have short leads and connect as directly as possible between the collector of Q1 and the junction of R2 and C2. Keep the leads to the crystal short also.

The unit is best mounted in a shielded box — such as a diecast box, and coax connectors used for the two outputs.

Many transistor types may be substituted for Q1 — such as: 2N3564, 2N2222, 2N5770, BC107, BC547, BC108, BC548, BC549 etc. TC1 can be a compression type trimmer, circular film trimmer or a beehive type (Philips). A trimmer having a maximum value of 100 pF or 50 pF may be substituted as most crystals are made to operate into a 30 pF or 32 pF load. Some are made to operate into a 50 pF load, others into a 100 pF load. Stray capacitance and b-e junction capacitance in Q1 will account for some of the load capacitance.

Current consumption is around four to five milliamps. ●

Notes for constructors of the ETI-1500 metal detector

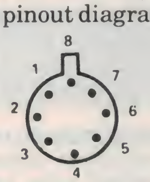


Corrected wiring diagram. Note the MODE switch (SW1) designations — see circuit, below left. The switch pole connections on PB2 and PB3 are uppermost. Take care with headphone socket (SK2) wiring. See note here.

THIS PROJECT, from the December 1980 issue, is apparently being tackled by a great many 'new chum' hobbyists and beginners. These notes are produced for constructors in these categories with a view to helping them get their project going and to keep it going.

Firstly, a number of errors crept into the original article, but these were largely corrected in the February issue (page 15). Reproduction of the photographic overlay in the original was variable, to say the least, but clear dyeline copies are available by sending a large stamped, self-addressed envelope to the magazine requesting the "ETI-1500 overlay". For those struggling to reconcile the circuit and the wiring diagram, corrections for the erroneous portions of the circuit are reproduced here (involving SW1, the MODE switch, and IC2a). A corrected wiring diagram also appears here. Note that all the external components and controls are viewed from the rear.

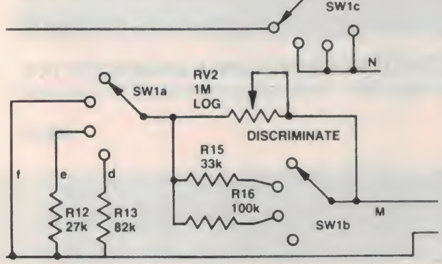
- Take special care with the orientation of IC5 (CA3130) if an 8-pin TO-5 (circular metal case) type is supplied. Refer to the pinout diagram below.



CA3130T TOP VIEW

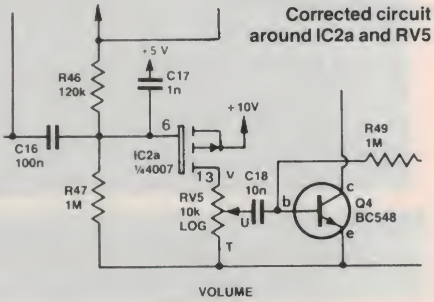
- Take care with the wiring of the headphone socket as not all types have the same, or similar, connections. Check this by examination or with a multimeter before wiring.
- Take care when wiring the DIN socket that connects the search head. The search head wiring is colour-coded, as shown on the circuit diagram. The red and black wires come from the receive coil. This coil has a dc resistance of around 50 ohms. The transmit coil is connected via the cable shield and the white wire. It has a dc resistance of around 12 ohms. There may be a yellow wire in the cable. Ignore it as it is not connected. The Faraday coil shields are internally connected to the cable shield.
- The wiring to the two pushbuttons PB2 and PB3 should first be sorted out with an ohmmeter before soldering it in place. Note that the switch pole contact is at one end — as shown here.
- The pushbutton in the handle needs to have good 'feel' and positive contact. One of the small C & K or Swann types should fill the bill.
- If you have used or are using a metal front panel, it should be earthed to reduce spurious capacitive effects. The body of the discriminate control should connect to 0 V (pin i) and a star washer should be inserted under its nut to provide a good contact to the panel. Otherwise, a plastic Scotchcal panel is recommended (one was used on the prototype).
- It is strongly recommended that a flux-removing solvent be used to clean the pc board following assembly. Whilst flux does not cause problems when 'new', many atmospherically borne chemicals can and do react with the flux in time. This causes a leakage path to be established between the tracks and is especially troublesome in high impedance circuits, such as around IC5. A de-fluxed pc board will obviate later (or early) problems with the auto-tune circuit; it also looks more professional and aids identification of defective solder joints. The effort is worth it.
- If you have trouble with hand capacitance effects, plastic knobs or collet knobs may be used to advantage on the controls, particularly the variable discriminate control.
- The wiring to the pushbutton in the handle should be done with shielded cable, passed through a hole drilled in the rear of the case to avoid fouling the telescopic shaft in the retracted position.
- A battery clamp, fashioned from a small strip of aluminium, is recommended.
- The case should be mounted as close to the curve in the handle as possible for optimum weight distribution.
- A screw or bolt should be placed through the rear case mounting clip to stop the case rotating on the shaft. The rear clip is recommended to allow the shaft to be telescoped to minimum length. •

Corrected circuit, SW1.



G.N. Vayro
Broadmeadows, Vic.

Corrected circuit around IC2a and RV5



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Infra-red remote control unit

This project can be used to operate mains-run equipment remotely at distances up to 10 metres, and it resists being 'fooled' by spurious infrared sources. The portable transmitter can be carried in your pocket and the controller can operate equipment drawing as much as 5 A from the 240 Vac mains.

Phil Wait
Simon Campbell

THIS PROJECT can be used to turn any mains-powered device, such as a radio, TV, heater, etc, on and off from ranges up to 10 metres, provided that the remote device is in the line-of-sight of the operator. The project uses an infrared remote control 'link' and does not need an operating licence, has no trailing wires to trip the unwary, is not susceptible to acoustic interference and does not generate radio or TV interference.

The control system consists of two separate units, a hand-held infrared transmitter and a remotely-located mains-powered infrared receiver unit with a bistable relay output. The relay output terminals are used as a 'switch' that makes or breaks the power feed to the device (radio, TV, etc) that is being controlled. The transmitter unit contains only one control, a press-button switch, which connects battery power to the circuit and causes a coded infrared beam to be generated. This invisible beam is aimed at the receiver and causes its output relay to change state, thereby giving an alternate ON-OFF-ON relay switching action via the transmitter.

We've taken a lot of trouble with this project to ensure that the system has both good range and high reliability, i.e: high sensitivity but excellent rejection of spurious and unwanted electrical and optical signals. This has resulted in seemingly complex circuitry in both the transmitter and the receiver. The project is therefore not suitable for the absolute beginner, but can be tackled with reasonable confidence by the novice with a moderate amount of constructional experience. The complete system uses only two preset controls, and can be set up without the use of test gear.

Design niceties

The project is built around the CQY89A infrared emitting LED and the BPW50 infrared sensitive opto-diode, both made by Philips. These operate at 930μ. The transmitter is pulse-coded and the receiver has a filter to ensure that spurious infrared emissions do not inadvertently operate the receiver.

The transmitter design takes advantage of the high peak current capability of LEDs to give a useful range of about 10 metres (which is what we obtained on our prototype) indoors, with a combination of daylight and artificial (fluorescent) lighting in the room. Quite positive operation at this distance is obtainable, although your aim has to be reasonably good.

The strength of the infrared beam produced using these LEDs is proportional to the number of LEDs used and the current passed through them. We have used two CQY89A LEDs and the transmitter circuit passes a *peak pulse current* through them of about 700 mA. By rapidly pulsing the LEDs on and off at a rate of about 25 kHz over a period of 300 microseconds, once every 10 milliseconds, the total on-time for a LED is only 150 microseconds in every 10 milliseconds. The *average* current through the LEDs is only 8 mA and well within their specifications.

Secondly, this technique enables the infrared beam to be pulse-coded so that the receiver can be arranged to distinguish between the beam and unwanted infrared emissions such as the sun, cigarette lighters, etc, in normal operation. The receiver sensitivity can also be greatly enhanced.

The receiver is provided with a high gain preamp following the infrared detector diode (BPW50), tuned to 25 kHz, having an adjustable bandwidth which effectively sets the sensitivity. This drives a subsequent ▶

The completed remote control unit. Scotchcal front panel suppliers are listed on page 67.

amplifier and detector, which provides an output to a bistable switch circuit that operates a relay. Thus, keying the transmitter on momentarily will operate the relay in the receiver, which will latch on. Keying the transmitter momentarily again will de-energise the relay, which will latch off. Thus, a simple PRESS-ON, PRESS-OFF operation is obtained.

With the receiver at maximum sensitivity, the unit can be triggered by a cigarette lighter held closer than 100 mm from the detector diode.

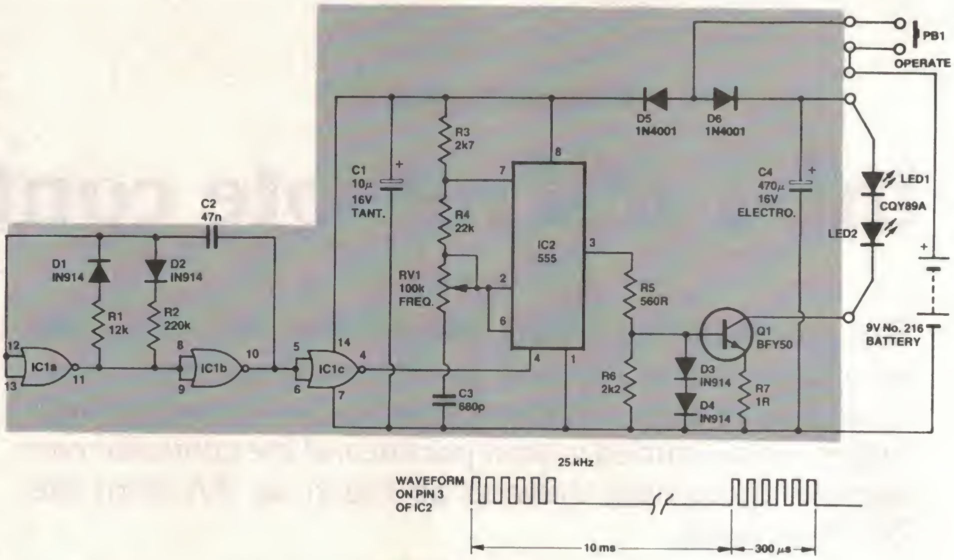
Although there is a multiplicity of pc boards, construction is relatively simple and if you've had a modicum of experience, you should have little difficulty getting this project going.

With the exception of the infrared LEDs and the opto-diode, all parts are readily obtainable. We have given kit and component suppliers plenty of warning regarding the CQY89A LEDs and BPW50 opto-diode, and these items should be widely stocked by the time this issue goes on sale. You can house your project in different cases from the ones we used in our prototype as actual housing is non-critical.

Construction — transmitter

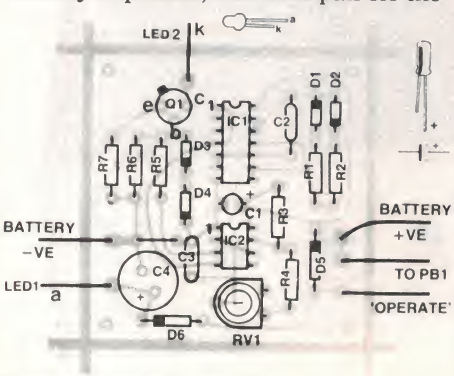
The transmitter is housed in a small, all-plastic box (an English-made BIM box) measuring 110 x 60 x 30 mm. It can be easily held in the hand or slipped into a pocket. Anything similar will suffice, providing the components can be fitted inside it. We mounted the 'operate' pushbutton on the lid and the two infrared LEDs in one end so that they can be easily pointed at the receiver/controller unit when held in the hand while the pushbutton is pressed by the thumb. Mark out and drill the case first of all.

Assemble the pc board (ETI-599a) first, being careful with the orientation of the two ICs, the transistor and the electrolytic capacitors. Attach the battery clip leads, a twisted pair for the



Transmitter circuit.

Internal view of the transmitter



Component overlay for transmitter.

HOW IT WORKS — ETI 599 TRANSMITTER

The transmitter circuit consists of two distinct sections, IC1 and IC2 (the waveform generator section), and Q1 and associated components acting as a high current driver for the infrared LEDs.

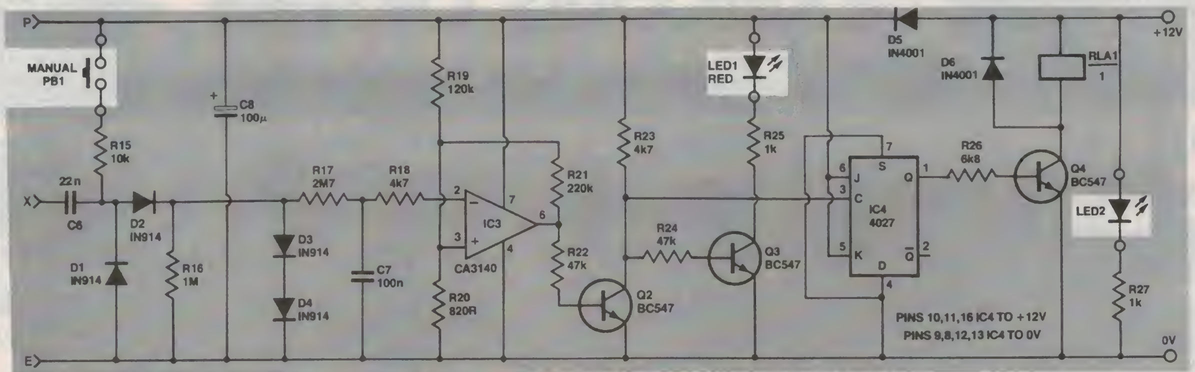
IC1 is a buffered, non-symmetrical square wave oscillator which generates a pulse of 300 μs wide every 10 ms. When power is first applied, C2 is discharged and the outputs of IC1a and IC1c are high. C2 charges from the high output of IC1a via R1 and D1. When C2 is sufficiently charged the output of IC1a goes low, IC1b goes high, and IC1c goes low. C2 starts to charge in the reverse direction, but this time through R2 and D2. The time constant of R1 and C2 determines the pulse width, while that of R2/C2 determines the period between pulses.

The output of IC1 gates a 555 astable oscillator, set to a frequency of about 25 kHz. The oscillation continues for 300 μs while the gating pulse is high and is repeated every 10 ms. The exact frequency of the 555 astable oscillator may be varied over a limited range by the trimpot RV1.

Transistor Q1 is a constant current generator with two infrared LEDs connected in series in its collector circuit. The base voltage of Q1 is clamped to 1.4 V by two silicon diodes in series, and as the base emitter drop in the transistor is about 0.7 V, the emitter voltage is clamped at 0.7 V. As the emitter resistor is one ohm, the maximum collector current before the transistor is cut off is thus 700 mA.

When the operate pushbutton is pressed, pulses from the output (pin 3) of the 555 turn on the constant current generator and cause 700 mA current pulses to flow through the two infrared LEDs. The capacitor C4 supplies the high current pulses to the LEDs as the small 9 V battery will not deliver current pulses of this magnitude. The capacitor is charged during the time between pulses and during the time between bursts. Supply isolation is provided by D5, C1 and D6, C4.

The light output from the LEDs occurs during the current pulses and appears as 25 kHz pulses for a 300 μs period, repeated every 10 ms as long as the operate pushbutton is pressed.



Receiver, detector and relay driver circuit.

HOW IT WORKS — ETI 599 RECEIVER

The receiver circuit can be divided into three distinct sections: a high gain frequency selective preamplifier (ETI-599b), a signal detector and bistable relay driver (ETI-599c), plus a power supply (ETI-599d).

The pulse-coded infrared beam is picked up by an infrared sensitive opto-diode, IRD1 (a BPW50) and appears as a pulsed voltage across R1. The detector diode has a frequency response which matches the transmitter LEDs for maximum sensitivity and rejection of unwanted emissions. The pulses are passed to the inverting input of IC1, a CA3140 op-amp, and amplified by a factor of 33 before being passed to IC2, another CA3140.

IC2 is an active Wien bridge bandpass filter tuned to approximately 25 kHz by C3/R8 and C4/R9. The transmitter frequency is adjusted to the centre frequency of this filter during the set-up procedure. The selectivity, or 'Q', of the filter is adjustable via RV1 and is set for the minimum possible bandwidth for reliable triggering to ensure maximum rejection of unwanted emissions incident on IRD1.

The output pulses from IC2 are further amplified by Q1 and passed to terminal X — the output of the preamplifier.

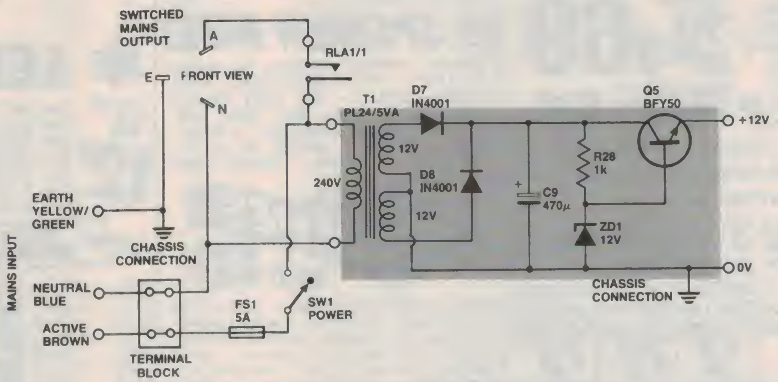
Capacitor C6 ac-couples the pulses into the detector circuit where they are rectified by D1 and D2. The detected pulses are peak limited by D3 and D4 to about 1.4 volts. The rectified pulses are integrated by R16 and C7 and appear as a rising dc level across C7 and the inverting input of IC3. When the transmitted signal ceases, capacitor C7 discharges through R16 and R15.

IC3 is a regenerative comparator whose output switches low when the voltage on the inverting input exceeds 100 mV or so. Because of the integrating action of R16 and C7, however, the input voltage is sufficient to switch the comparator only after the transmitted signal has been present for about 200 ms. This ensures the circuit does not respond to transients or spurious signals.

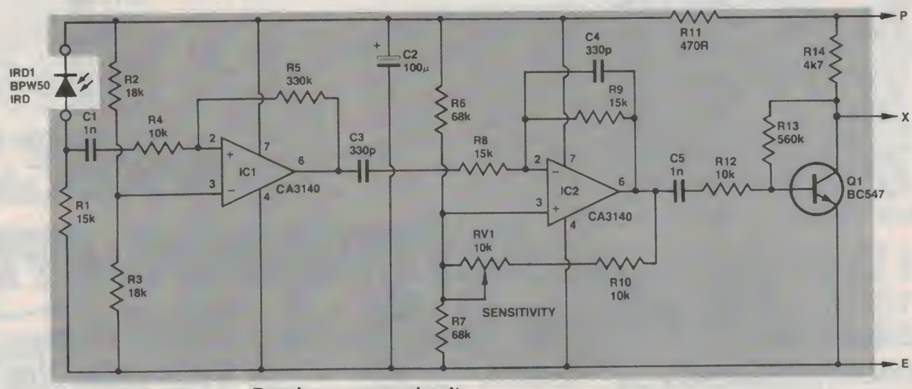
As the output of IC3 switches low, Q2 is turned off and the voltage on its collector goes high. Q3 is turned on and LED1 lights, giving a visual indication on the front panel of the receiver unit that a signal is being received.

When the collector of Q2 goes high, a clock pulse is fed into IC4, a bistable multivibrator, which changes state. The relay is switched, via Q4, from off to on or vice versa each time the coded transmitter signal is received, provided it is sufficiently strong and at least of 200 ms duration. The receiver is powered from a regulated 12 volt power supply using a zener diode, ZD1, as a reference on the base of a series-pass transistor, Q5.

The relay contact is used to switch the active mains through to a panel-mounting mains socket for switching 240 V operated appliances.



Receiver, power supply and mains wiring circuit.



Receiver preamp circuit.

INFRA-RED REMOTE CONTROL UNIT ETI-599a TRANSMITTER

Resistors .... all ½W, 5%

R1	12k
R2	220k
R3	2k7
R4	22k
R5	560R
R6	2k2
R7	1R
RV1	100k min. flat-mounting trimpot

Capacitors

C1	10u/16 V electro.
C2	47n
C3	680p
C4	470u/16 V electro.

Semiconductors

D1 to D4	1N914, 1N4148 etc
D5, D6	1N4001
LED1, LED2	CQY89A infra-red LED
IC1	4001B
IC2	555
Q1	BFY50

Miscellaneous

ETI-599a pc board; SPST miniature pushbutton switch; 9 V No. 216 battery; battery clip, LED mounts; plastic jiffy box 115 x 65 x 30 mm, wire, nuts and bolts, etc.

Price estimate

We estimate that the cost of purchasing all the components for this project will be in the range:

$70 - $76

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.

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1"	20W dome tweeter, 400-20,000Hz	ea	$ 8.95
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4	27.055	15	27.185
5	27.065	16	27.195
6	Sold Out!	17	27.205
7	27.095	18	27.225
8	27.105	Marine	27.880
9	27.115	Marine	27.890
10	27.125	Marine	27.900
11	27.135	Marine	27.910

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pushbutton and flying leads for connections to the LEDs last. The two LEDs are mounted in panel mounts which require two 6 mm holes to be drilled in the end of the case.

The pc board can be mounted in the case using a piece of double-sided sticky tape or pad, but leave sufficient room for the battery in the end opposite the LEDs. See the internal photograph of the transmitter. Wire up the LEDs, watching the anode and cathode connections.

Remember that you won't be able to tell if the unit is working by looking at the LEDs because, as infrared is well outside human visibility, you won't see anything. If you have an oscilloscope, look at the waveform across R7. It should be similar to that shown in Figure 1 here, taken on our prototype.

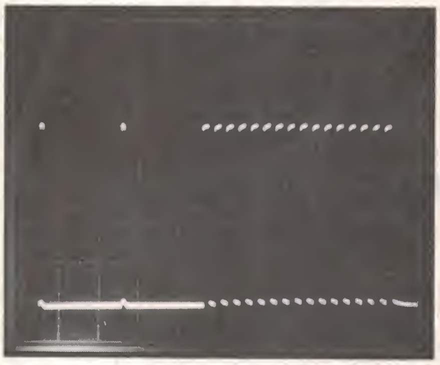


Figure 1. **Transmitter waveform, monitored across R7 on pc board ETI-599a. Vertical scale 100 mV/div.; timebase 5 ms/div. for first four divisions, showing 25 kHz burst repetition, then 100 μs/div. for rest of sweep showing 25 kHz pulses.**

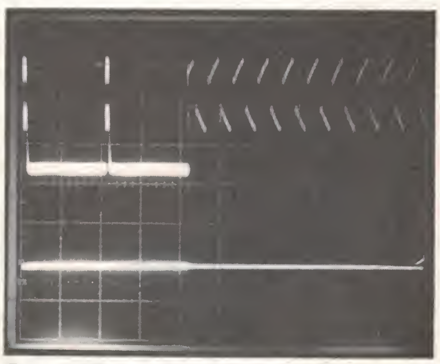


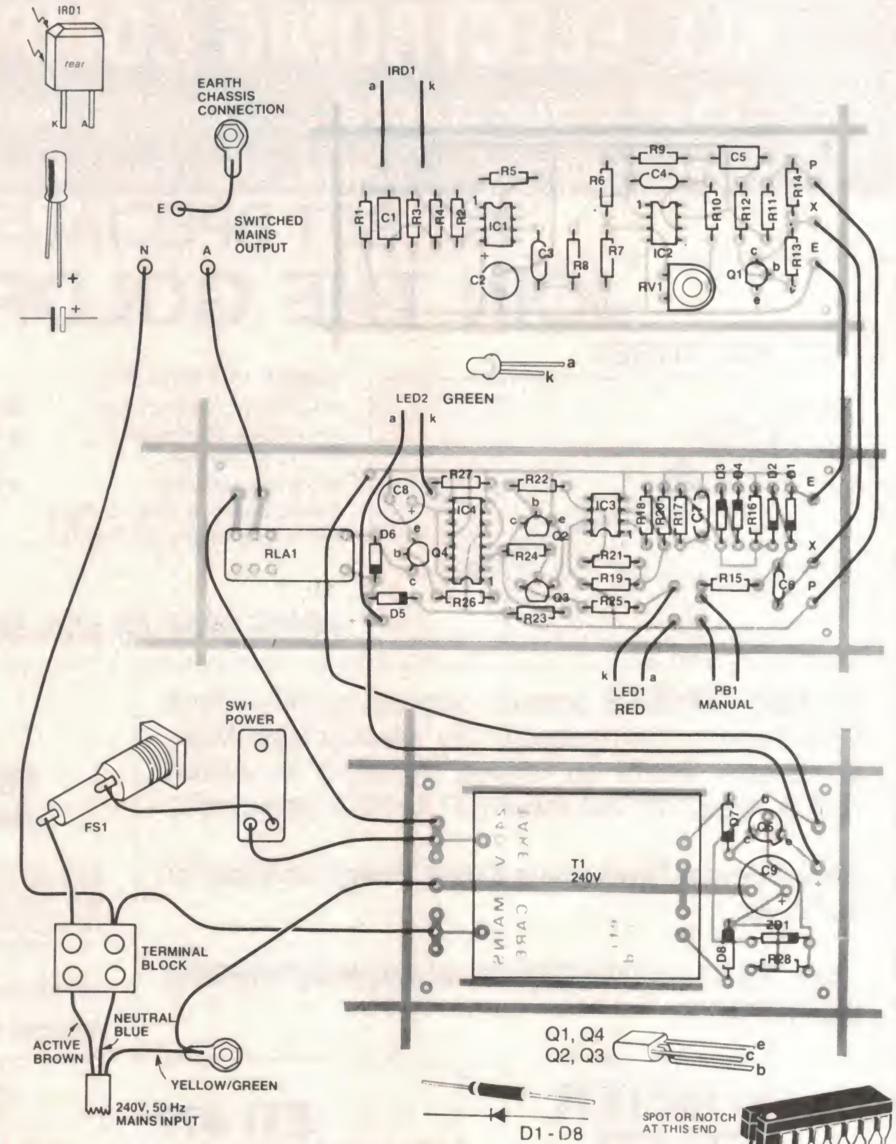
Figure 2. **Received waveform monitored across R1 on pc board ETI-599b. The transmitter was positioned 250 mm from the receiver diode. Vertical scale 20 mV/div. dc coupled; timebase 5 ms/div. for first four divisions then 50 μs/div. for rest of sweep. The bottom trace is 0 V. Signal voltage across R1 will vary greatly with the distance between the transmitter and receiver units.**

Construction — receiver

The receiver is built on three separate pc boards — preamplifier and active filter (ETI-599b), detector and relay (ETI-599c), and a regulated power supply (ETI-599d). It is all housed in a metal box measuring 150 x 70 x 175 mm with an overhanging lid. The front panel holds the two LEDs, power switch, fuse and infrared opto-diode. The 240 V mains socket for the switched output mounts on the rear panel alongside the mains lead. All mains wiring is kept well away from the low voltage circuitry and we used a cardboard partition just in case.

It doesn't matter which pc board you assemble first. Assemble all the boards, being careful with the polarity of the electrolytic capacitors and the orientation of ICs and transistors. The two frequency determining capacitors in the active filter, C3 and C4, should be styroseal or mica types for good temperature stability.

With the boards assembled, attach flying leads to each for later interwiring. Plastic insulated, 240 Vac rated wire, at least 32 x 0.2 mm, should be used for all mains wiring.



Component overlays and wiring diagram for receiver.

The case for the receiver may be drilled next, if you haven't obtained a predrilled one. Refer to our internal photograph for positioning of the boards and external components. Layout is not critical, but the mains wiring should be kept separated from the rest of the circuitry.

We mounted the preamp/filter board (ETI-599b) immediately behind the front panel. Behind this we mounted the detector/relay board (ETI-599c), with the power supply board (ETI-599d) at the rear. Each board is mounted using four bolts at each corner, the boards being spaced off the chassis using 12 - 15 mm long brass or fibre spacers.

Now the interwiring may be completed. As suggested earlier, use 32 x 0.2 mm plastic insulated hookup wire for all mains wiring.

Install the heavy cardboard protective partition last. It may be bolted or glued in place.

The infrared detector diode is fixed behind a hole in the front panel. We mounted ours on a small piece of vero board glued edge-on to the rear of the front panel. A small piece of filter plastic is then slid in front of the diode and glued in place. This is not essential but does improve the appearance. If you use a piece of filter plastic make sure it is the correct type which will pass infrared. We used 'Kodak Wratten 89c' but any similar type will do.

The infrared detecting diode, BPW50, is a flat package made from what appears to be black plastic. In actual fact, the package is made from a filter material which passes infrared and absorbs visible light — this is why it appears black. If you look at the top edge you will notice a chamfer on the corner of one of the faces. This is the *non-sensitive* face and should be positioned *inwards*.

When the receiver has been constructed, check the mains wiring VERY CAREFULLY and ensure the earth connection is firmly attached to the chassis. Make sure the input active goes to the output active, input neutral to output neutral. Plug a lamp or some other mains appliance into the switched outlet and switch the unit on. Adjust the receiver trimpot RV1 so that LED1 is off and check the functional operation of the unit by pressing the 'manual' button briefly. As this pushbutton is pressed LED1 should light and the relay should change state, making or breaking the power to the load. When the manual switch is released, LED 1 will go out but the relay should not change state.

Setting up

With the receiver unit operating by itself, adjust the trimpot RV1 (sensitivity) so that LED1 lights up, then back the control off slightly until LED1 just goes out. Take a deep breath, cross your fingers and aim the transmitter at the receiver from a close range. Press the 'operate' button and if all is well, LED1 on the receiver unit will light and the relay will change state. Release the operate button, wait a second or so, and press it again. The relay should revert to its original state.

When you are satisfied the system is operating correctly you can adjust the transmit frequency for maximum sensitivity, or range. Adjust the trimpot RV1 in the transmitter (frequency) while operating the transmitter at increasing distances from the receiver. You should be able to obtain reliable operation at a range of about 10 metres maximum. Do this adjustment with care, making sure you aim the transmitter directly at the receiver.

Have fun with your controller! ●

ETI-599 RECEIVER

Resistors .... all ½W, 5%

R1, 8, 9	15k
R2, R3	18k
R4, 10, 12, 15	10k
R5	330k
R6, R7	68k
R11	470R
R13	560k
R14, 18, 23	4k7
R16	1M
R17	2M7
R19	120k
R20	820R
R21	220k
R22, R24	47k
R25, 27, 28	1k
R26	6k8
RV1	10k min. flat-mounting trimpot

Capacitors

C1, C5	1n greencap
C2	100u, 16 V electro.
C3, C4	330p styroseal or mica
C6	22n greencap
C7	100n greencap
C8	100u, 16 V electro.
C9	470u, 25 V electro.

Semiconductors

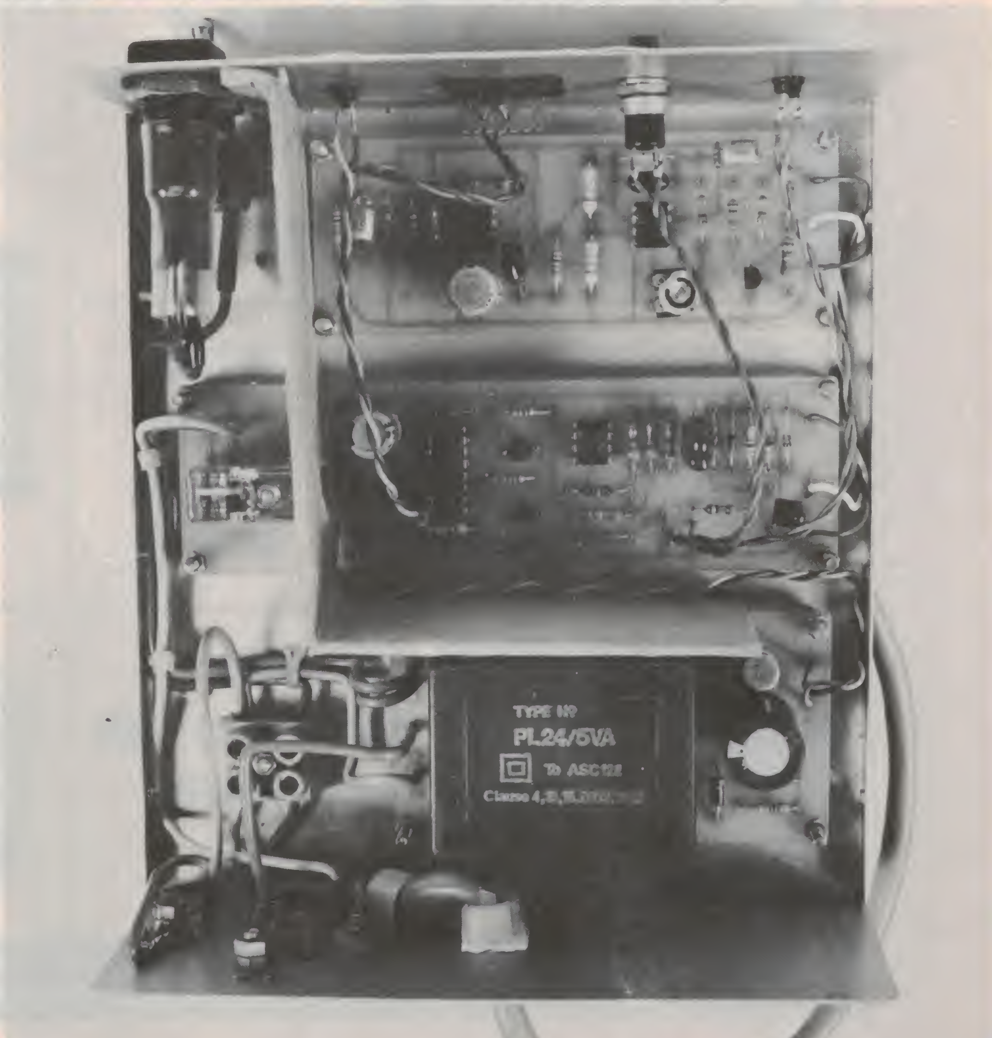
IRD1	BPW50 infra-red photodiode
LED1	TIL220R red LED
LED2	TIL220G green LED
D1 to D4	1N914
D5 to D8	1N4001
ZD1	12V, 400 mW zener
Q1 to Q4	BC547, BC107 etc
IC1 to IC3	CA3140
IC4	4027

Miscellaneous

PB1	SPST min. momentary push button
SW1	SPST toggle switch, 240 Vac rated
RL1	12V, pc board relay with DPDT 240 Vac/5 A contacts (Takamisawa type VB 12STAN or Pye 265/12/G2V)
T1	12-0-12 V, 5 A pc mount transformer, Ferguson type PL24/5VA or sim.

Panel-mount fuse holder and 5 A fuse to suit; mains cord; cable clamp; terminal block; panel mount three-pin mains socket; LED filter material — Kodak Wratten 89C or similar (small piece); metal box and lid 160 x 180 x 70 mm; stick-on rubber feet; three pc boards ETI-599b, c and d; wire, nuts, bolts etc.

Internal view of the receiver unit. The cardboard 'shield' separates the 240 Vac wiring.

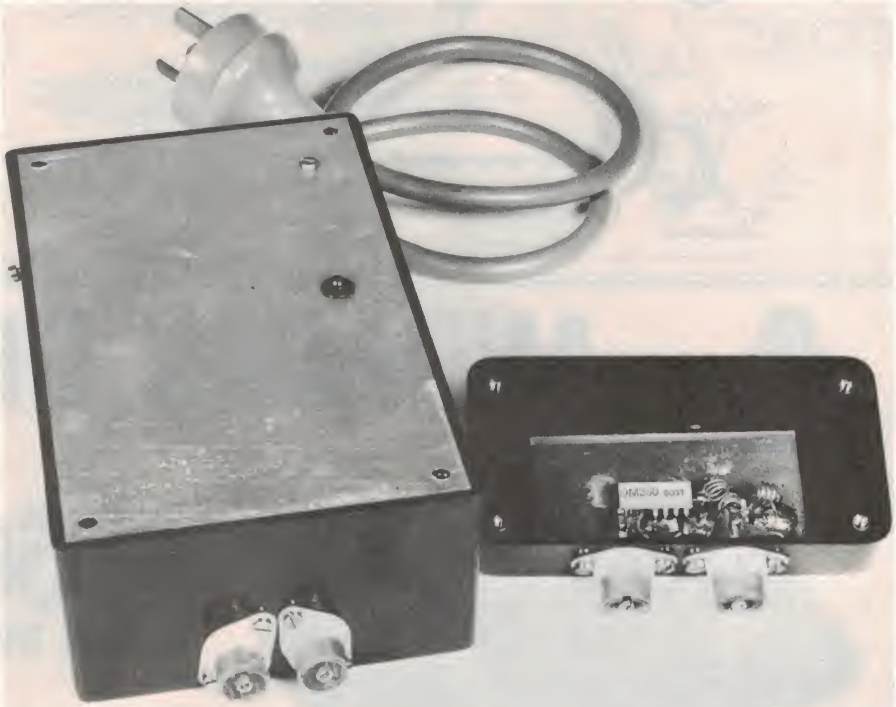


Project 729

Masthead amp for UHF TV

If your UHF TV signal is not quite up to scratch and you don't want to add more aerial hardware, this project is for you.

Phil Wait



WHEN INSTALLING a UHF TV antenna system it is often difficult to predict *up front* just how good a picture you're going to get, whether you'll have noise (snow) problems, etc. Undoubtedly, situations will arise where, having installed the antenna and feedline, the picture is found to be acceptable, but contains some snow. Alternatively, having erected a large expensive antenna array and installed expensive, top-quality coax, the picture is 'out of the mud' but not acceptable on anything but a short-term basis. Either way, erecting more hardware may not be as good a solution as attempting to boost the signal at or near the antenna with a suitable booster amplifier. That's where this project comes in.

In other situations, long runs of feeder cable may be necessary. Traditionally, 300 ohm open-wire feedline is regarded as 'low loss'. It's not so at UHF. Coax performs better 'upstairs' and suffers less from the effects of weather and picks up less unwanted interference. However, a very long run may have as much as 5 to 7 dB loss, sometimes more. This not only attenuates the signal before it reaches the TV front end, but seriously degrades the tuner's noise figure — and you lose both ways. Again, that's where this project comes in.

The ETI-729 UHF TV Masthead Amplifier covers the UHF TV bands IV and V, extending from 526 MHz to 814 MHz. It provides nearly 18 dB of gain and has a noise figure typically around 6 dB.

Heart of the amplifier is a recently-released Philips wideband hybrid amplifier, the OM350. It is a two-stage amplifier built on a thin-film substrate and encapsulated in a 5-pin, in-line package having a resin-coated body. It is part of a range of five VHF/UHF wideband amplifiers made by Philips, which include the OM345, OM360, OM361 and OM370. We have published a short-form data sheet on the OM350 elsewhere in this article.

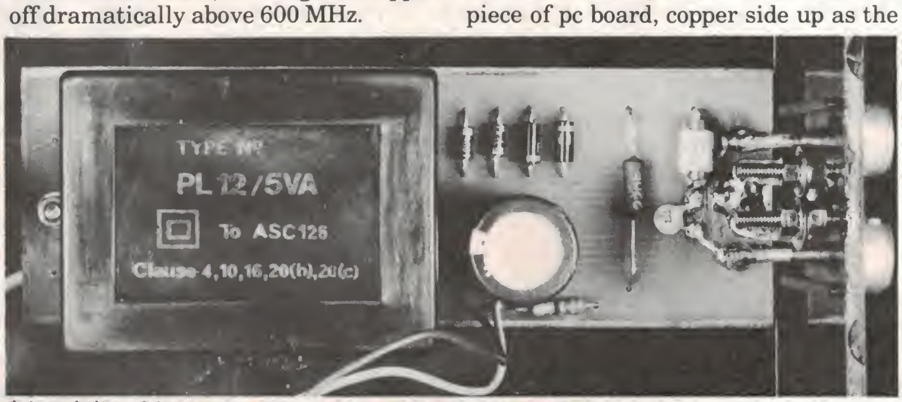
Construction

The amplifier is housed inside a small plastic box which is contained within a larger plastic box for weather proofing, the latter being attached to the antenna mast.

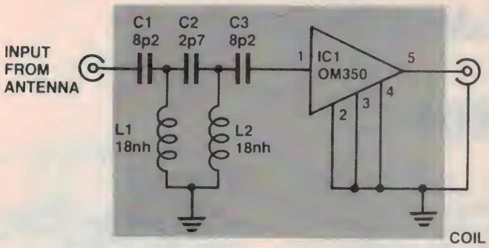
Unlike most of our projects, the amplifier does not use a pc board, but rather the components are wired to each other directly and mounted above a flat copper earth plane. This construction is quite easy and gives good results up to quite high frequencies, avoiding the cost of Teflon pc board and specialised components. In fact, our first attempt at making this amplifier used printed inductors for the high pass network and microstrip terminations. Probably owing to the pc board characteristics and the Q of the printed inductors, this was not successful, as the gain dropped off dramatically above 600 MHz.

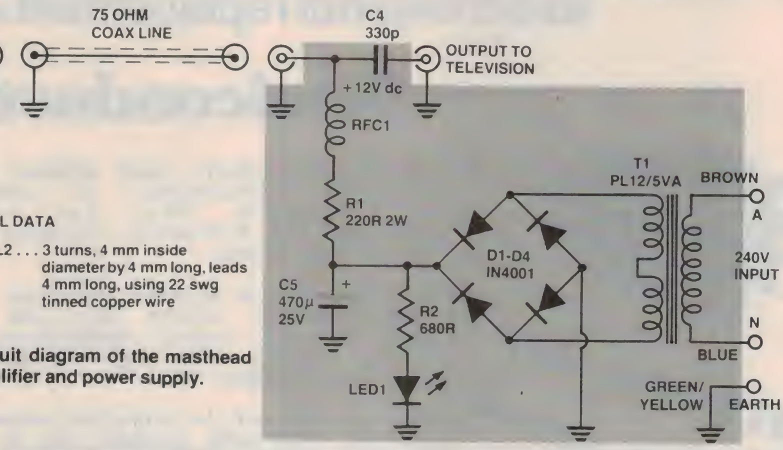
Follow the drawing and photograph of the amplifier very carefully. All earth connections from the coax sockets, the IC and the filter inductors are made directly to the copper ground plane. All the components have absolutely *minimum* or no lead length and you will find a pair of tweezers may help to hold the components while soldering.

Start by mounting the coax sockets about 30 mm apart on the side of the box, with their bolt holes in line with each other. Place two solder lugs under the two innermost mounting bolts for the coax sockets, and to these solder a piece of pc board, copper side up as the



Internal view of the power supply. Note the pc board is double-sided.

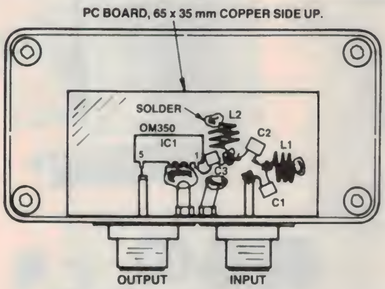




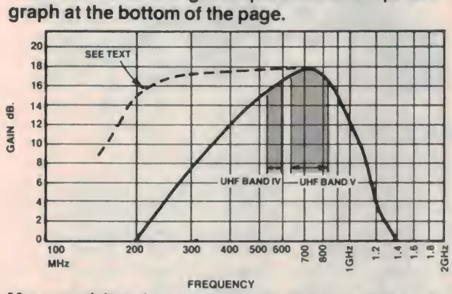
COIL DATA

L1,L2 . . . 3 turns, 4 mm inside diameter by 4 mm long, leads 4 mm long, using 22 swg tinned copper wire

Circuit diagram of the masthead amplifier and power supply.



Construction drawing. Compare this to the photograph at the bottom of the page.



Measured bandpass and gain characteristics of the amplifier. You can alter the response to that shown by the dotted line by adding one turn to L1 and L2.

earth plane. Its exact size is relatively unimportant, so long as it fits in the box. Wire all the components as shown. The three earthed leads on the IC are bent down slightly and soldered onto the earth plane while the output lead is bent up to the output socket, and the input lead solders to the high pass filter.

Be careful not to overheat the coax sockets as the Belling and Lee types used are easily melted.

Drill a small hole (about 3 mm) near the coax sockets to allow ventilation in the box to avoid condensation build-up. Fix the lid in place with Silastic rubber.

Weatherproofing

The amplifier box is contained in a larger box, which is attached to the antenna mast with a U-bolt. Drill clearance holes for the coax plugs so they can be passed through the bottom of the larger box to the amplifier. After mounting the box on the mast and connecting the coax cables, seal the lid with Silastic rubber.

The power supply

The power supply is located near the TV set and housed in its own plastic box. Commence construction by mounting all the components on the pc board, noting that C4 and RFC1 are soldered on the top side of the board. Again, use

HOW IT WORKS — ETI 729

The masthead amplifier is based on one of the Philips range of wideband hybrid integrated circuits. The OM350 features 18 dB gain from 40 MHz to 860 MHz with a noise figure of around 6 dB. Input and output impedances are 75 ohm, allowing the IC to be directly connected in line without impedance matching.

As the output of the chip is open collector the dc power is fed along the output signal path (in our case, the centre of the coax), making the IC ideal for masthead operation.

The signal from the antenna is applied to the input of IC1 via a high pass filter network with a cutoff frequency of about 400 MHz. As this amplifier will be used on antennas designed only to receive UHF transmissions it is desirable to prevent strong HF or VHF stations from being amplified and fed to the TV set. If so, some receivers may be prone to intermodulation, causing interference patterns on the screen.

The high pass filter comprises C1, C2, C3, L1 and L2.

The amplified signal is fed down the coaxial cable to the power unit mounted close to the television receiver. The signal passes through a blocking capacitor, C4, and is fed to the receiver's antenna input. The dc power is applied to the line on the amplifier side of C4 through an RF choke to prevent the signal being shunted by the power supply circuitry.

The power supply consists of a full-wave rectifier producing about 16 V filtered dc which is dropped to about 12 volts by R1. A LED indicates when the unit is switched on.

ETI-729 UHF TV MASTHEAD AMP

Resistors

R1 . . . . 220R, 2W
R2 . . . . 680R, ½W

Capacitors

C1, C3 . . . . 8p2 ceramic (NPO)
C2 . . . . 2p7 ceramic (NPO)
C4 . . . . 330p ceramic (NPO)
C5 . . . . 470u/25 V electro.

Semiconductors

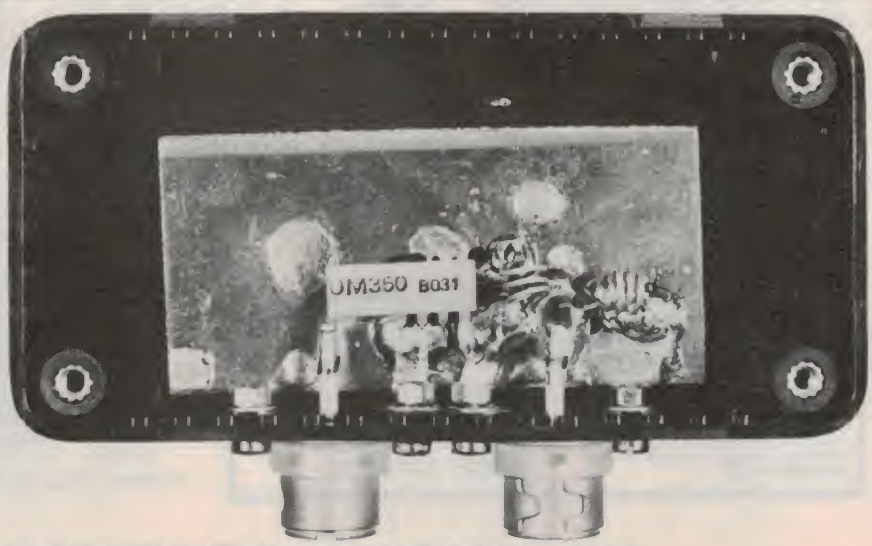
D1 to D4 . . . . 1N4001 or similar
LED1 . . . . TIL220R red LED
IC1 . . . . OM350 Philips wideband RF amp

Miscellaneous

ETI-729 pc board; four Belling-Lee coax sockets; four solder lugs; RF choke (see text); Ferguson PL12/5 VA transformer or similar; 240 Vac power cable and plug; plastic box — 100 x 50 x 25 mm (for amp); plastic box — 195 x 110 x 60 mm (weather protector housing); plastic box — 160 x 95 x 50 mm (power supply); 22 swg tinned copper wire, etc.

Price estimate $28 - $34

Note that this is an **estimate** only and **not** a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.



Internal view of the amplifier. A piece of pc board serves as an earth plane.

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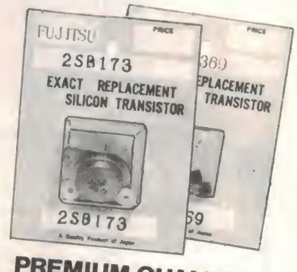

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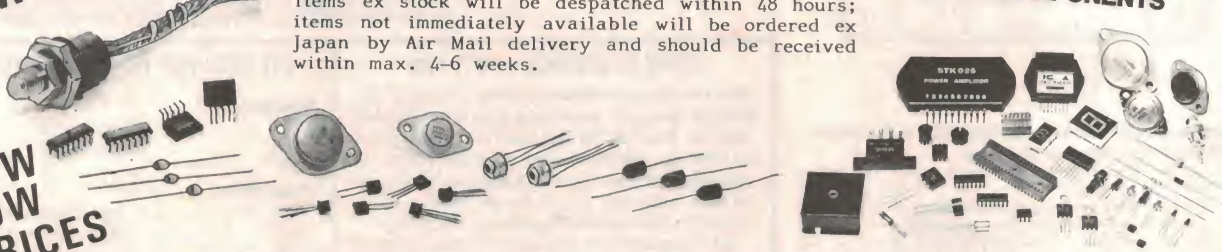

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2SA471 0.82	2SB889 0.46	2SC403 0.70	2SC900 0.48	2SC1312 C.37	2SC2092 3.18	AN245 6.80	HA1199 3.84	BA511A 3.54
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2SA496 0.98	2SB175 0.52	2SC509 0.88	2SC959 2.10	2SC1359 0.40	2SD199 4.75	AN315 4.10	HA1452W 2.68	MB3712 2.90
2SA518 0.70	2SB178 0.62	2SC515A 1.79	2SC960 2.38	2SC1364 0.66	2SD213 10.45	AN331 6.85	Mitsubishi IC's	MB3713 2.90
2SA550 1.20	2SB186 0.48	2SC535 0.87	2SC973 29.50	2SC1390 0.45	2SD234 1.56	AN7115 3.20	M5115AP 6.55	Miscellaneous
2SA562 0.52	2SB187 0.48	2SC536 0.37	2SC995 3.30	2SC1407 0.98	2SD235 1.45	AN7150 4.70	M5116 2.50	LM1820 2.25
2SA564 0.44	2SB263 0.58	2SC538 0.87	2SC1000 0.52	2SC1417 0.58	2SD261 0.59	Toshiba TA IC's	M5152L 1.95	LM2902A 3.66
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2SA683 0.65	2SB439 0.95	2SC732 0.54	2SC1114 10.10	2SC1520 1.74	2SD380 10.50	TA7205P 3.39	LA1202 2.78	
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2SA697 0.74	2SB492 1.29	2SC734 0.59	2SC1128 1.17	2SC1624 1.60	2SD389 2.17	TA7214P 7.80	LA3301 3.05	
2SA705 0.98	2SB507 3.50	2SC735 0.46	2SC1129 1.19	2SC1628 1.57	2SD414 0.98	TA7222P 4.20	LA3350 3.57	
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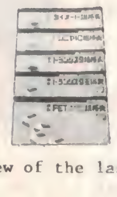

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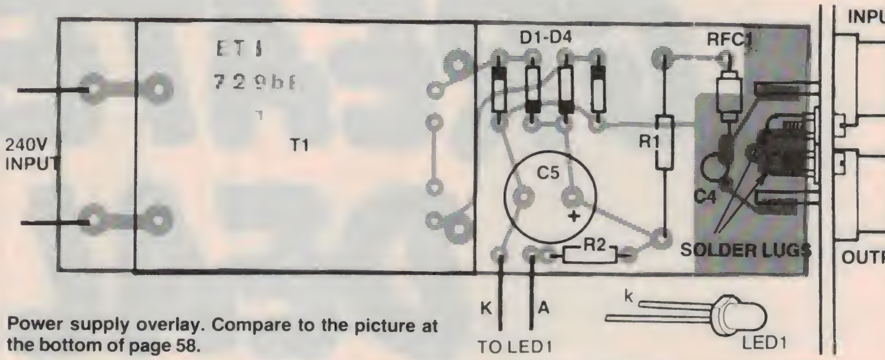
—CUT OUT THIS PAGE AND KEEP FOR FUTURE REFERENCE—

as short leads as possible. The value of the RF choke is not critical though you should use one which is physically small. We used a commonly available 10 uH choke, though any value above 500 nH should be OK. Mount the two coax sockets at one end of the box exactly 18 mm apart, as shown, again using two solder lugs on the two inside bolts as we did on the amplifier box.

The pc board is supported with one standoff near the transformer and by the connections to the coax sockets at the opposite end. Again, be careful not to melt the coax sockets with too much heat. The 240 Vac power cable terminates directly onto the pc board as we have used a pc mounting transformer. The earth lead (green/yellow) should be firmly soldered onto the two earth lugs at the coax sockets. Leave plenty of slack in this lead so if the cable is pulled from the unit the earth is the last to break off.

Finally, you will have to assemble a patch cord with a coax plug on either end to run from the power supply to the TV set. Use a good-quality coax for this as, although it is short, performance can be seriously degraded if you use a lossy cable ahead of the amplifier. ●



Power supply overlay. Compare to the picture at the bottom of page 58.

OM 350

HYBRID INTEGRATED CIRCUIT VHF/UHF WIDEBAND AMPLIFIER

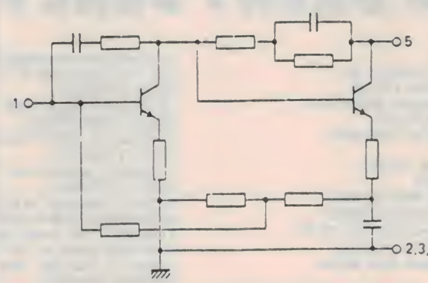
Two-stage wide-band amplifier in hybrid integrated circuit technique on a thin-film substrate, intended for RATV and MATV applications.

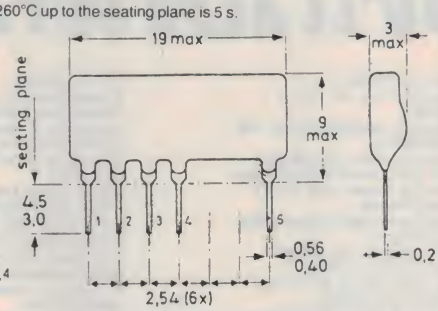
dc supply voltage	V_B	=	12 V ±10%
Frequency range	f		40 to 860 MHz
Source and load (characteristic) impedance	$R_S = R_l = Z_o$	=	75 Ω
Transducer gain	$G_{tr} = \|s_f\|^2$	typ.	18 dB
Flatness of frequency response	$\pm\Delta\|s_f\|^2$	typ.	1 dB
Output voltage at −60 dB intermodulation distortion (DIN 45004, 3-tone)	$V_{o(rms)}$	typ.	100 dBμV
Noise figure	F	typ.	6 dB
Operating ambient temperature	T_{amb}		−20 to +70 °C

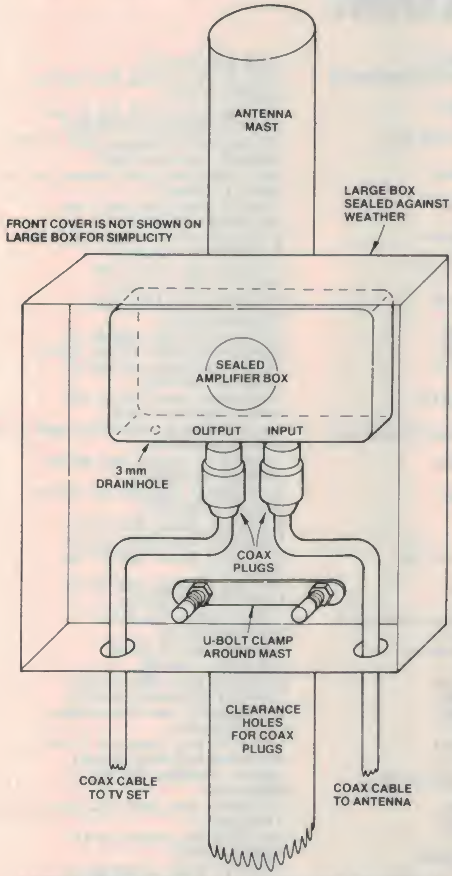
ENCAPSULATION 5-pin, in-line, resin-coated body

Terminal connections
1 = input 2,3,4 = common 5 = output/supply(+)

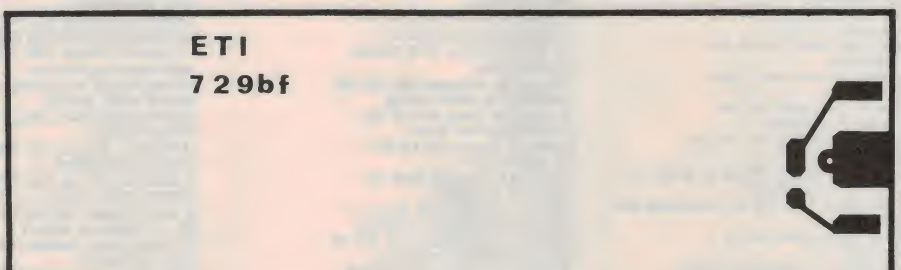
Hand soldering
Maximum contact time for a soldering-iron temperature of 260°C up to the seating plane is 5 s.

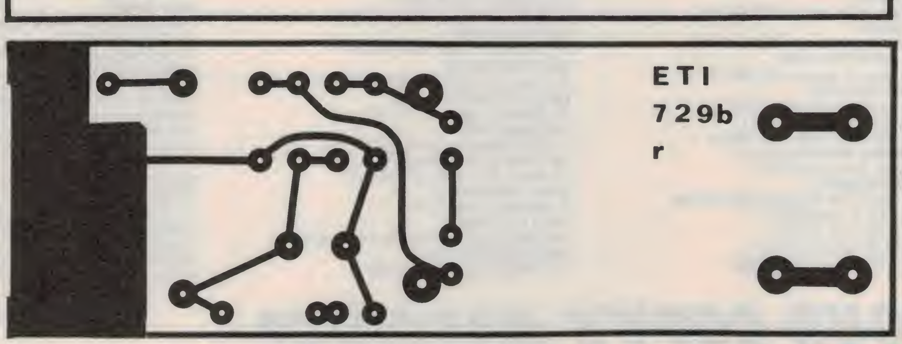






ABOVE: Suggestion for mounting the amplifier in a weatherproof housing.



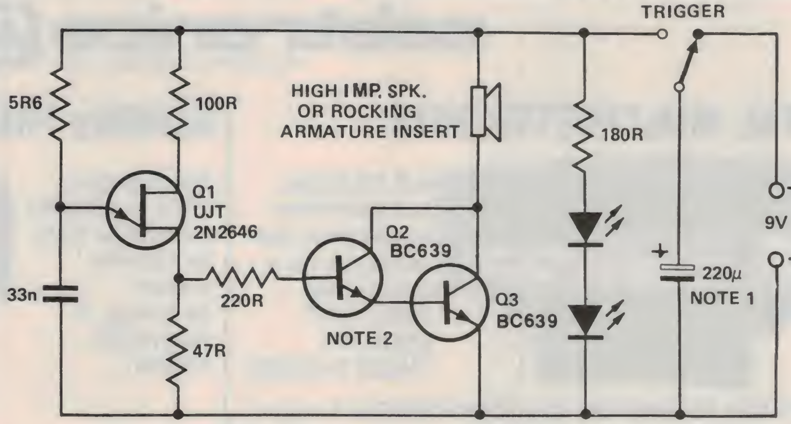


RIGHT: Printed circuit artwork, full size.

Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.

Zap! Pow! Zeep, zeep! — vaporise those Cylons!



NOTE 1
VALUE MAY BE REDUCED IF LEDS ARE NOT USED
DURATION OF SOUND PULSE DEPENDS ON VALUE USED

NOTE 2
AMPLIFIER ARRANGEMENT TO SUIT SPEAKER (ROCKING ARMATURE TELEPHONE RECEIVER IMPEDANCE APPROX. 100R)

Star Wars, Star Trek and Battlestar Galactica have brought a new dimension to electronic technology — as any eight or nine-year-old child will tell you (and at length).

This circuit, from **W.H. Spriggins of South Melbourne,** can be assembled into a suitable plastic toy 'space gun' and will keep the junior space warriors happy for ages (until they save up for a really-truly laser, that is).

A simple high-pitched oscillator, having plenty of harmonic output, is made from a UJT oscillator. This drives a straightforward Darlington audio output stage. Sound is produced by a rocking armature insert (telephone type) or a high impedance speaker (75 or 100 ohms, for example). The circuit is 'triggered' by a spring-return push-button (SPDT). An electrolytic capacitor is charged by the battery when the trigger is not pressed. When the trigger is operated, the 220 uF capacitor discharges via the circuit. Discharge is rather rapid and a short 'zeep' (rising tone) is emitted and the two LEDs light up.

Go get them Cylons!

Identify IC pins with ease

This idea was sent to us by **A. Bendeli, CSIRO Division of Applied Physics, Sydney, NSW 2070.**

IC manufacturers provide a visual clue to identify the orientation of an integrated circuit — a notch, a dimple or a printed dot. This mark also defines the order in which the pins are numbered. This is fine if an IC is to be inserted in the pcb and never serviced. When it comes to servicing and probing the IC during development, debugging or troubleshooting, a lot of time is wasted in counting pin numbers to reach the correct pin.

ICs with 14 and 16 pins have a small enough number of pins to identify the correct one easily. Problems arise when 24, 28, 40, 52 or 64-pin ICs are used. Imagine having to probe pin 45 on a 64-pin package, or pin 31 on a 40-pin IC. You either count backwards or forwards all the way from a chosen edge of the package, and ten to one lose track whichever way you go.

Additional marks added on top of package

One solution is to include more visual clues, for example by taking the following approach using white typewriter correcting ink. Short lines for pins 5, 15, 25 . . ., and long lines for pins 10, 20, 30 . . ., are painted on the black plastic body.

Another alternative is to scribe such lines. For a 40-pin package, the markings would be as shown. Visual observation of the lines immediately defines the numbered pin closest to the desired location.

The writer suggests that the cost of implementing such lines as a part of the plastic moulding process or type number printing of an IC package would be minimal. Maybe the manufacturers could take up this idea.

Any ideas ?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

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PRICE: KIT $120 + tax = $138
Assembled $140 + tax = $161

600MHz FREQUENCY COUNTER 8610

Specification: 10Hz to 600MHz guaranteed (5Hz to 750 MHz typical). Sensitivity ≤ 10mVRMS – 100MHz,

50mVRMS- for 100 to 450MHz, 70mVRMS 450 – 600MHz Temperature Stability 0.1ppm/C. Gate time .1 sec 1 sec 10 secs. Ageing rate ≤± 5ppm/year. Accuracy 1ppm + 1 digit. Protection: 90VRMS at 10KHz – 10VRMS at 600MHz

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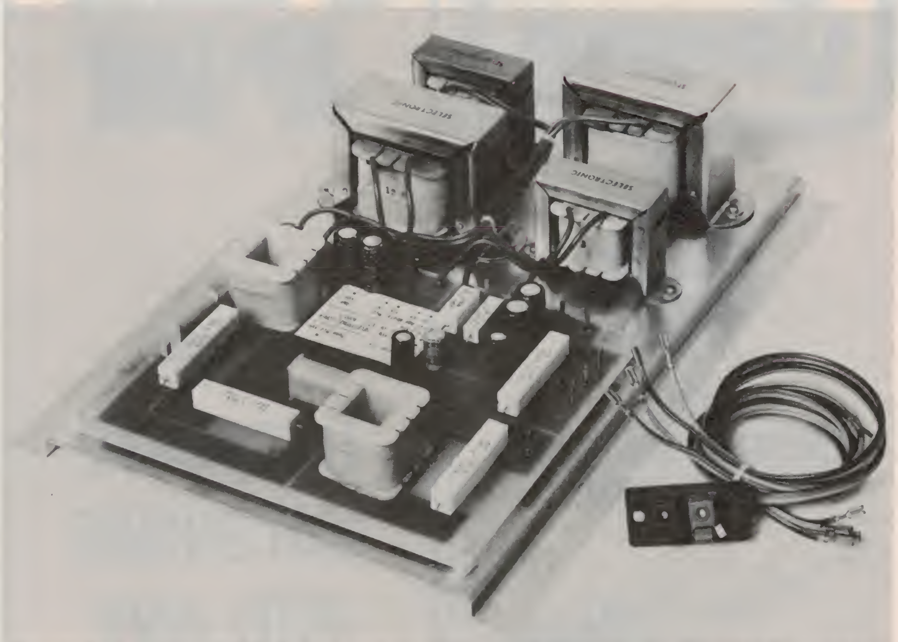
Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here.



You can now obtain ready-built, high quality crossover networks for our very popular ETI-4000/1 Four-Way Loudspeaker system. These are manufactured, with approval from ETI, by Selectronic Components of Bayswater in Victoria and are currently distributed by Rod Irving Electronics of 425 High St, Northcote Vic. (03)489-8131. These units have quick-connect terminals with precut leads and no soldering is required.

ETI-1501 negative ion generator

This project only has two components which could be regarded as 'specialised' — the FX2242 potcore and the plastic used in the emitter head. Everything else in the project is over-the-counter stock. The potcore is stocked by Dick Smith Electronics and George Brown & Co (in NSW and ACT) — try their agents; also Browntronics in Victoria and Protronics in S.A.; All Electronic Components, Rod Irving Electronics and Radio Despatch Service. The plastic for the emitter head construction can be obtained from most plastics suppliers, such as Cadillac Plastics, but some hobby shops and hardware stores also stock it.

So far as we are aware at time of going to press, the following suppliers will be stocking kits, or pc boards and all components, for this project: Dick Smith Electronics, Radio Despatch Service, Electronic Agencies, All Electronic Components, and Rod Irving Electronics.

ETI-567 core-balance relay

This project only sports one specialised component — the FX2242 potcore, the same as used in the Negative Ion Generator. Suppliers as noted previously. We used a Fujitsu 12 volt relay type FRL264/DO12/O2CK. The 24 volt version is type FRL264/DO24/O2CK. Fujitsu relays are distributed by IRH Components of 53 Garema Circuit, Kingsgrove NSW 2208, (02)750-6444. A number of suppliers stock these, we understand. The DEC type MC2U is a similar style of relay, having the same pin layout as the Fujitsu type FRL264, but is meant to be mounted in a socket. It can be mounted on our pc board by drilling holes and filing slots. The DEC type MC2U relay is stocked by Dick Smith Electronics, catalogue No. S-7200. Note that the above relays are rated to switch 10 A at 240 Vac (unity power factor). Types rated to switch only 5 A may be used if you so wish. Suitable types are the Takamisawa VB 12STAN, Fujitsu FRL621DO12 and Pye 265/12/G2V. All are widely stocked.

ETI-729 UHF masthead amp

Heart of this project is a Philips wideband hybrid amplifier chip, the OM350. This is stocked by Radio Despatch Service in Sydney; in Melbourne it is stocked by Magraths, Ellistronics, Rod Irving Electronics, All Electronic Components and Tasman Electronics. All other components can be obtained 'off the shelf'.

ETI-599 infra-red remote control unit

This project is built around the Philips CQY89A infra-red LED and BPW50 infra-red opto-diode detector. Everything else is bog standard. The CQY89A should be obtainable from Radio Despatch Service and Electronic Agencies in Sydney; in Melbourne, from Magraths, Rod Irving Electronics, All Electronic Components, Tasman Electronics, Radio Parts, Kalextronics (101 Burgundy St, Heidelberg), Ray Cross Electronics Supermarket (151 Boronia Rd, Boronia) and Polykits (317 Swanston St, City).

The BPW50 is a little more scarce; however, in Sydney try Radio Despatch Service and Electronic Agencies. In Melbourne try Magraths, Rod Irving Electronics, All Electronic Components and Kalextronics (address above).

We understand this project will be widely stocked as a kit, or pc boards and components.

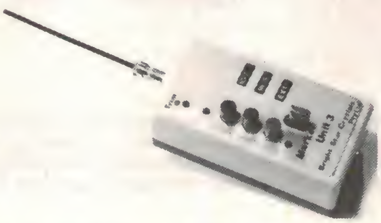
Scotchcal panels

Scotchcal panels for this month's projects, indeed for most projects published over the last two years, are generally stocked or can be supplied by the following firms:

Radio Despatch Service
869 George St
Sydney. (02) 211-0816

All Electronic Components
118 Lonsdale St
Melbourne. (03)662-3506

Rod Irving Electronics
425 High St
Northcote. (03)489-8131



Britain legalises CB

The British Home Office announced late in February that it intends to legalise CB Radio, possibly to be introduced in autumn.

The authorised band will be on 27 MHz, but only for frequency modulated (FM) transmissions. A further band in the 930 MHz region will also be permitted.

However, this announcement has certainly not met with an unqualified welcome. The Government has admitted that some 63 000 illegal AM CB sets are in use (although others estimate the figure is over 250 000) and these people are most annoyed at the prospect of having to buy new equipment before they can legally use the new service.

Indeed, there have been marches of people demonstrating against the announcement in British cities.

The 'National Campaign for the Legalisation of CB' has qualified its welcome with disappointment over the choice of frequency, since it would have liked one of the frequencies in the region of 41 MHz at present being used for monochrome 405-line television transmissions, which are to be discontinued.

British manufacturers are just as unenthusiastic, since they say the 27 MHz band will open the way to a flood of foreign-made equipment. Philips Industries stated that the legalisation of 27 MHz favours the Japanese and would be no good to any British manufacturer.

However, retailers are welcoming the decision and expect a boom in CB equipment sales lasting for two years, after which the market will find its normal level, they predict.

The Home Secretary said that 930 MHz was favoured for the second band, but there was public demand for a lower frequency; the final decision had to take into account the need for an early introduction of the service, the risk of interference to other services and the desirability of adopting an international standard. It is felt that the 27 MHz FM system should give much the same performance at about the same cost as the illegal equipment currently in use, but should generate far less interference with other services than AM.

Other countries in Europe have 27 MHz FM CB, while 930 MHz will be adopted in North America and part of Europe to provide a high quality service.

Other frequencies, such as 41 MHz and 450 MHz, were considered, but were not felt to meet interference requirements, etc.

Users of the new CB service will be required to buy a licence, renewable each year, which will entitle them to use either frequency. Specifications for the new equipment will be drafted to ensure interference is minimised and manufacturers, importers and assemblers will have to conform to the standards.

CB equipment will have to be permanently marked so that purchasers know it conforms to the legal standards. The illegally used equipment has given rise to some 5000 complaints in the past five months of interference to radio, television and hi-fi.

CB users who have been transmitting illegally are reported as saying they will stay illegal on AM rather than buy new equipment for FM, but many others will doubtless follow the Government requirements.

This raises the problem as to how officials can easily check whether a CB user has AM or FM equipment in his car or home. It would be a massive job to stop motorists on the road frequently to check whether they have AM or FM equipment, but unless action is taken, Britain will most likely have as many CB radio pirates as are presently operating!

Brian Dance

Electromagnetic compatibility advice available

The problems of operating transmitters in close proximity to domestic and other electronic appliances would be familiar to many hams.

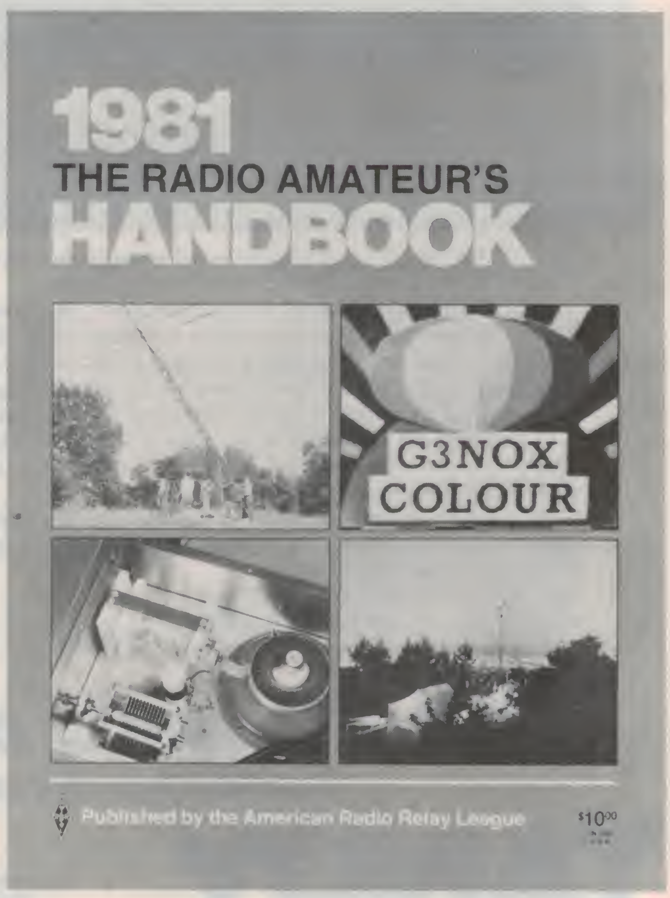
Advice on EMC problems is now available courtesy of a new service set up by the Federal Executive of the Wireless Institute of Australia (WIA). Advice is available to all Australian amateurs, whether an Institute member or not, from the Federal EMC Coordinator, VK3QQ, 38 Wattle Drive, Watsonia Vic 3087.

1981 Handbook

The 1981 Radio Amateur's Handbook, published by the ARRL, should now be available through outlets in Australia.

This year's Handbook has been expanded by 64 pages to a total of 640 pages and is again in the new, large format measuring 216 x 280 mm. The book contains 23 chapters, covering every aspect of communications technique and technology from basic electronics through to FM and repeaters, wave propagation, antennas etc. and including the ever-popular chapter with vacuum tube and semiconductor data tables.

Check with your book dealer. Those likely to stock the 1981 ARRL Handbook are: Dick Smith Electronics, Technical Bookshop, McGills Newsagency etc.



LETTERS

Dear Sir,

Upon two past occasions I have written to you and received extreme courtesy and prompt and meaningful responses. Since you obviously rely to some extent upon customer feedback in connection with published projects I would like to contribute the following for whatever it is worth and without requirement of a reply.

ETI 4000

For some years I have been hoarding a set of beautifully figured teak-veneered particle board panels for some future loudspeaker project. And this was it.

But the panels were only 36" long, not 39.3" as per ETI 4000 design. Further, a clumsy accident after carefully mitring the joints caused me to reduce the overall height to 35 inches. To provide some compensation for the now reduced cabinet volume the plinth was reduced to 2½ inches and the dome mid-range and tweeter fitted in a staggered configuration. Vertical linear array was of course not possible. The crossovers were installed inside the cabinets.

Volume reduction was a height reduction and pinched from the top ends, thus cutting down both woofer and mid-range chambers.

1½ x 1 inch hardwood strips were glued into rebates within the panels to provide a sound fitting base for back and baffle panels.

In addition a crosspiece was fitted so that the back could be screwed up across the middle. Further, this crosspiece was joined to a brace from the underside of the mid chamber, effectively forming a 'T' piece link between baffle and back.

The back was crossbraced with 1" x 1" hardwood in order to minimise any resonance, and the whole lined with two layers of good quality carpet underfelt.

The back was screwed at 6 inch pitch around the perimeter. This turned out to be not good enough and later the back was Recourcinol'd to form a solid seal.

The cabinets were as dead as any I have encountered and a quick rap with the knuckles produced a sound like knocking on the Eastern Freeway!

How would the reduced volume affect the performance?

The results were really quite good, but I have KEF Cantata ears and they were (the ETI 4000s, not the ears!) generally a long way short of my expectations. For two days I brooded upon how, for just a little more outlay, I could have bought a pair of JBL s.

My existing Grundig Box 506 loudspeakers (bookshelf units) had always been 'clinical' in the extreme and my Ortofon MC cartridge certainly warmed them up a bit. Perhaps I should try my old M91ED Shure?

My friends, your loudspeaker design has shown up flaws which I never dreamed existed and I wouldn't swop 'em for a pair of KEF Cantatas now! Firm balanced bass, incredible transient handling and incapable of being driven into distortion with my B & O 4000 (40 W into eight ohms output). I find that my amp is not as good as I had previously imagined — likewise my cassette deck. My God, what have you started?

Naturally I do not know what difference the slightly reduced cabinet volume has had, because I don't have the originals with which to compare them. But I suspect it has had no effect at all. In fact, it just might be that the slightly more compact configuration in combination with the extra bracing measures taken have produced a stiffer housing and better sound!

I thought perhaps you would like to know.

Ian Stuart
North Balwyn Vic.

Dear Roger,

I must congratulate you and ETI on the magazine's content and format relating to electronic theory and its applications to relevant projects. This was seen particularly in the article by David Tilbrook on the 477 mosfet power amplifier module and the other projects in the Feb. 81 issue.

I consider this theoretical information an excellent idea, which I hope will continue. You have an excellent magazine, and I have just renewed my subscription for another twelve months.

Neil A. Teese
West Brunswick Vic.

Dear Sir,

In the January edition of your magazine a Mr John Keenan queries the authenticity of the first direct drive turntable. I believe they were in Brisbane in the 1930s; certainly they were advertised in English magazines around that era. I believe there were also some American counterparts. I am not quite sure if they were self-starting; on the few occasions I saw them demonstrated the operator helped them along with his finger.

It should be realised that the greater number of record enthusiasts did not use electrical amplification at that time, and the ordinary electric gramophone motors were high-speed motors governed by the same means as the spring motors of the time.

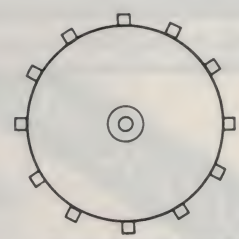
I have an old book, 'AC Motors of Fractional Horse-power', written by H.H. Jones, printed in London and New York, 1938 edition. It illustrates a gramophone turntable using a synchronous type of motor. The motor was in two parts, the rotor or turntable and the stator. The stator had a small shaft which fitted into a ball bearing in the rotor. On the underside of the rotor can be seen the rectangular points of a series of permanent magnets arranged in opposite polarity. The stator carried the same number of coils and poles carrying ac current. For dc current the number of poles was given by the formula:

$$\frac{2 \times 50 \times 60}{78} = 76.9 \text{ poles.}$$

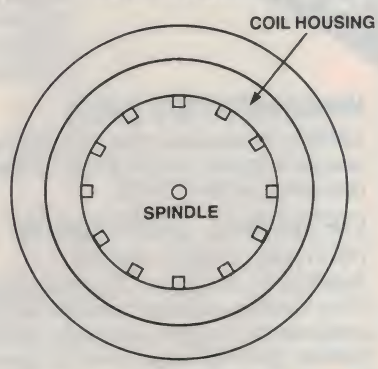
The motor was constructed with 76 poles and ran fast by 0.9 rpm.

I have tried to cut back the description to save space, but the chief advantage of the motor was its lack of depth. I should think today all those magnets under the record would play havoc with the modern pickups!

R.A. Young
Townsville Qld.



ROTOR AND MAGNETS



STATOR

Evidently the rotor had another top which acted as the turntable for the record — looks like a flattened-out clock motor.

BARGAIN BASEMENT BOOK SELLOUT!

ETI CIRCUITS NO.2.
A collection of ideas and data for the electronics experimenter. This book contains 25 chapters: Alarms, Amplifiers, Automobiles, Batteries, Comparaters, Conversion Tables, Crossovers, Crystal Oscillators, Detectors, Digital, Filters, Indicators, Logic Data, Miscellanea, Miscellaneous Data, Mixers, Preamplifiers, Power Control, Power Supplies, Sequence Timing, Signal Generators, Signal Processors, Special Effects, Switching, Test. As you can see, it covers many fields and there are a wealth of circuits. 100 pages.
STREWTH! $1.25 (down from $2.95)

TEST GEAR VOL.1.
This rare gem contains over 30 projects covering every field from audio to digital, physical measurement to RF. You'll find ever-popular projects like the ETI-438 Audio Level Meter, the ETI-704 Crosshatch/dot Generator, the ETI-129 RF Signal Generator, the ETI-121 Logic Pulser and ETI-122 Logic Tester plus power supplies, a temperature meter, simple frequency counter etc., etc. 116 pages
A MERE $1.25 (as against $3)

TOP PROJECTS VOL.5.
How can you resist this one? Over 20 projects, covering many fields of interest, from photography to P.A., control to biomedical applications, novelties to alarms. In this one you'll find such things as the Transmission Line Speaker, Graphic Equaliser, Marine Gas Alarm, Accentuated Beat Metronome, Shutter Speed Timer, GSR Monitor, Ultrasonic Switch, CB Power Supply, Digital Temperature Meter, Skeet Game, White Line Follower and more, more, more. See — how *can* you resist? 116 pages.
OH DEAR! $1.30 (cover price $3)

30 AUDIO PROJECTS
This weighty tome is a must for the audio enthusiast. A beautiful production on top-quality paper, the projects include such perennials as the ETI-440 Simple 25 W Amplifier, the ETI-414 Master Mixer, the ETI-449 Balanced Microphone Amplifier, the ETI-481 12 V 100 W Amplifier, the ever-popular 50/100 W ETI-480 Power Amp Modules, the ETI-487 Audio Spectrum Analyser, the ETI-441 Audio Noise Generator plus many more goodies. 164 pages.
A STEAL! $1.50 (was $3.95)

PROJECT ELECTRONICS
Our all-time best seller. Over 25 projects in this book, most of which have *never* appeared in ETI. All simple, easy to get going projects using common parts and generally powered by a single 9 V No. 216 transistor radio battery. Kits are currently available from several sources. Inside are such goodies as a continuity tester, two crystal sets, an AM radio, a battery saver, a simple intercom, a LED dice, a tachometer, an intruder alarm, a train controller, a hi-fi speaker — and lots more. *Plus* a guide to project construction, how to solder and how to find your way around components. A must for the beginner or tinkerer. 84 pages.
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In short — the bible. 204 pages
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COMPUTING TODAY

The all-singing, all-dancing, walking, talking computer . . . well, almost

Computers should soon be able to program themselves, following the success of two Britons in giving computers the ability to accept instructions in everyday language.

Computing specialist David James and businessman Mr S. Banbury of Ilminster in the west of England have spent 18 months developing a programming system which they have cryptically named 'The Last One' . . . theoretically the last program that need be written by a human being.

This program enables a computer to program itself automatically within minutes as the result of a question-and-answer session with the person who wishes to use it.

Through questions projected on a TV screen the computer can ask the non-specialist programmer — perhaps a manager, company accountant or some other executive unversed in the ways of computers — to define his or her desired program. The specification of the program is thus built up in everyday language, eliminating the tedious task of writing a long program in a computer language and spending weeks testing it for errors.

There are already some systems, called program generators, that can produce limited computer programs, but James and Banbury believe that The Last One is far more comprehensive, flexible and easy to use.

The new system will be handled by a company called DJ-AI Systems, which derives its name from David James' work on artificial intelligence. The Last One is not yet ready for commercial use, as at present it still requires an experienced systems analyst to use it, but the two developers are confident that within six months it will be ready for use by people with no computing background.

New System-80

Dick Smith recently announced the release of the new improved System-80. The best feature of this new machine is that it now has a built-in level meter for monitoring the playback level from program tapes being loaded via the internal tape deck. Along with the meter is a convenient level control, allowing the user to compensate for recording level differences between tapes.

These two features are designed to solve all the normal tape loading problems, which are probably the biggest bugbear with all small computers. Also provided in the new System-80 are two keys which were not present on the original model: a TAB or 'forward arrow' key, and a CLEAR key. These make the machine easier to use, and give it improved capability with programs written for the Tandy TRS-80 Level II machine.

Prices for the new System-80 remain as for the old. The unit with 4K of user RAM (X-4003) is still \$695, while the 16K version (X-4005) costs \$750.

Both versions of the new machine are still entirely compatible with the S-100 Expansion Unit (X-4010) and other matching expansion hardware. They are also fully compatible with earlier machines.

Sinclair ZX80 Contest Winners!

This contest attracted an *incredible* number of entries! By the time the contest finished our office manager, Jan Collins, could barely lift the box full of entries. If we run any more contests like this she's threatened to put in for a disability allowance!

The winning entry was sent in by Peter McGrath of Bendigo in Victoria. Congratulations, Peter; you should be having fun with your ZX80 by the time this appears in print.

The six runners-up were: Nicholas Jackman of St Ives, NSW; D. Batey of Clayton, Victoria; C.E. Rose of Roleystone, W.A.; Thomas McKenna of Ballarat, Victoria; P. Cusack of Asquith, NSW; and Grant Walker of Flinders Island, Tasmania.

Here are the answers:

- What programming language is used in the ZX80?: **BASIC**.
- How many keystrokes are required to enter words such as RUN, PRINT, LIST, etc?: **ONE**.
- How many standard graphic symbols are included?: **22**.
- Can the ZX80 be programmed to play chess?: **YES**.
- In which country is the ZX80 made?: **ENGLAND (or Britain, etc.)**.

The COSMAC VP-111 — a 'hands on' learner's micro

The COSMAC VIP range of microprocessor products, introduced to readers on page 71 of our February issue, is probably one of the cheapest ways of getting into microprocessors. Here, Jonathan Philips takes a good look at the bottom-of-the-range VP-111 board.

The VP-111 supplied for review came from J.R. Components, P.O. Box 128, Eastwood NSW 2122. (02)85-3385.

THE VP-111 IS a microprocessor development system which uses the 1802 processor, a little RAM and ROM, a video interface based on the purpose-built 1861 chip, a cassette interface and a numeric keypad.

I should perhaps point out that the VP-111 is nowhere near a fully-fledged 'personal computer' — it won't talk to you in BASIC or other 'high-level' languages. At most, you can get it to perform a few simple tasks, play games, etc. But then again, it's not intended to be a 'super-calculator'. The usefulness of the machine lies in what you will learn between the time when you buy it and the time when you find its limitations.

Having said that, the VP-111 is the **bottom** of a very extensive range of add-ons and expansion hardware which will enable you (with the aid of a little cash) to expand your VP-111 into something that **is** a full-fledged personal computer, with such facilities as BASIC, colour video, a full 'typewriter' keyboard, 32K of RAM, etc.

Mechanics

The VP-111 comes partially assembled (the user has to solder on a few cables and add a regulator chip).

The whole thing is built on a single printed circuit board, with the keypad mounted directly on the board. The keypad is of the 'conductive rubber' type — it's rather like pressing a rubber mat. There's no tactile feedback. For this reason, a small speaker attached to the board gives a 'beep' every time a key is pressed — so that the machine can tell when you've pressed hard enough. Unfortunately, whoever designed that part of the circuit was a little over-zealous. The beeper is **loud!** After only a few minutes of pressing keys, I was forced (yes, **forced** — by a member of my household) to disconnect the speaker!

The board also carries a switch which gives a 'break in' facility — it stops the machine doing whatever it happens to be doing at the time and returns control to the monitor.

Three LEDs on the board give an indication of the machine's status and of the input level of the cassette interface. There's a fair amount of room for expansion on the board, as well as places to attach multi-way sockets for off-the-board expansion.

The board is a little 'naked' on its own, and RCA have produced a plastic cover which leaves only the user-operated parts exposed. With a bit of ingenuity you could throw something together yourself if you're **really** trying to cut costs, though.

Input and output

There are three main I/O connections on the board — a video output (unmodulated), an audio output and an audio input for cassette storage.

The video output gives a six-digit hex display under the control of the monitor — four address digits, and two digits to show the contents of the addressed memory.

The entire screen is memory-mapped by the use of the 1861 video interface chip. This clever little device generates a composite video output, drawing its data from a specified area of system memory, and making use of the processor for timing to ensure that the system runs at high speed and without 'glitches' on the screen during screen memory access.

The screen resolution is 64 wide by 32 high — this requires 256 bytes of memory and, due to the small amount of memory provided in the basic machine, some of the screen RAM is used for temporary storage during monitor operation. This means that, while the monitor is operating, random dots appear on the upper part of the screen, and change as information is keyed in!

The cassette interface is fairly straightforward, giving an 800 baud signal (I think — the manuals are a bit sketchy about this). A nice feature is that a board-mounted LED gives an indication of the level of input, so that the start and end of programs can be spotted.

Operating it

The VP-111 monitor (which takes up the whole of the machine's 512 byte ROM) allows the user to perform four very basic functions: memory examine and modify, tape read and tape write.

As there are no 'special function' keys to allow control of the monitor, the first key pressed after reset determines the function selected — O for memory write, A for memory read, etc. This can be the cause of some errors — especially if you tend to forget where you are in a key sequence.

Tape read and write allow the user to store 256-byte 'pages' singly or up to 15 at a time, starting at any address. This means that programs can be re-located by using the cassette to record them, then playing them back with a different start address.

After mastering the monitor (which doesn't take long), the next step is loading the 'interpreter'. RCA have developed an interpreter (called CHIP-8) which fits into an incredibly small 512 bytes. Now here is my first and major complaint about the VP-111. After providing leads for the cassette, manuals and even self-adhesive rubber feet for the pc board, RCA have missed out one very important item — a cassette with CHIP-8 on it. The user has to key in all 512 bytes by hand from the manual. Although this may not seem like all that much, you have to remember that if you turn the interpreter loose and it doesn't work, you have **no** way of finding out what mistake you've made (except checking it against the printed version a few times, that is).

Now, I consider myself fairly familiar with keyboards (I've been typing for nearly 10 years), and I fully realise that a great deal of care and attention has to be exercised when typing in machine code, but it took me three hours of trying before I got CHIP-8 to do **anything.**

Now you can say that the cost of the pre-recorded cassette would have been an unnecessary expense for the first-time buyer who wanted to keep things nice and cheap. Fine. Try telling him that after three hours of keying in hex digits!

Having got that off my chest, I will now proceed with the rest of the review!

CHIP-8 is not an interpreter in the ▶

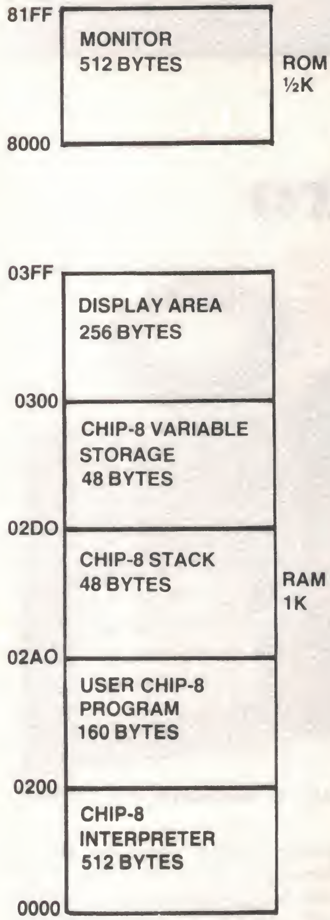


Figure 1. **VP-111 memory map, with CHIP-8 'installed' in RAM.**

same sense that most BASIC systems are interpreters — for one thing, it doesn't have an editor. This means that the instructions have to be entered directly into memory locations, and are written in hex.

Writing a CHIP-8 program is just like writing machine code, except that the instructions are more logically constructed, and that the 'machine' for which the code is written has some powerful features. For example, generation of random numbers by a single instruction, providing 'beeps' of known duration, providing timing functions and putting a pre-defined shape on the screen at any given location.

All of the above features are designed with one thing in mind — TV games. The manual that comes with the VP-111 is full of games — all written for use with CHIP-8. There's nothing wrong with that, of course; the VP-111 is a machine which provides a learning base for the user, and learning is what games are all about.

The memory map for the VP-111 is given in Figure 1 (with the CHIP-8 minimum on-board RAM). As each CHIP-8 instruction takes two bytes, it's easy to see that the maximum number of CHIP-8 instructions per program (80) is a bit of a squeeze for even quite simple tasks. Some of the examples of CHIP-8 programs given in the manual actually cross the O2AO threshold, which is allowable only because that particular program doesn't have a very deep level of subroutine nesting — the stack starts at O2DO and goes down.

Naturally, for any serious application outside simple control functions, more RAM would have to be added to the board. The VP-111 has room for a further 3K of RAM on board — this can be added by the use of the VP-114 expansion kit, which also gives the VP-111 eight buffered and latched input and output lines — which makes the board a serious contender for simple microprocessor applications.

The micro on the VP-111 is the CDP1802, which runs off a single +5 V supply (as does everything else on the board — we used a dc plug pack as a power supply and fitted a 5 V regulator in the space provided on the board).

The system's crystal clock (3.5 MHz) is used to run both the 1802 and the 1861 display generator chip. The latter is a cunning device, which simply attaches across the internal buss of the system and (with due regard for the memory timing of the processor) outputs an area of memory, dot for dot in video, with a screen resolution of 64 wide by 32 high (dots, not characters). The 1861 is capable of producing a display 64 wide by 128 high, but for reasons of memory usage this has been curtailed in the VP-111.

The output of the 1861 is video, and so a modulator is required if you want to use a domestic TV for output.

The keyboard decoding is done with a single chip — a CD4515 — which sits between four of the buss connections and one of the 'sense' inputs of the 1802. The CD4515 is simply a four-line to sixteen-line demultiplexer — but remember, the VP-111 keyboard has no 'special function' keys, and so only 16 keys are required.

Cassette input and output are directly from and to the processor itself, with only a little filtering. The cassette standard used is fsk, with bursts of tone at either 2 kHz or 800 Hz.

And that's about it! The VP-111 is a good example of how **little** you need to produce a fully-operational microprocessor system these days.

The 1802

The RCA 1802 is a CMOS microprocessor — this means that it has an extremely low power consumption (typical quiescent 10 **micro**amps), and that it has **no** minimum clock frequency (execution can be slowed or even stopped by manipulation of the clock — handy for software development).

The processor is an 8-bit device, with a 64K addressing capability. Instruction fetch-execute time for 5 V operation is 7.5 microseconds.

The internal organisation of the processor is interesting — there's an 8-bit accumulator, then sixteen 16-bit 'general-purpose' registers, any one of which can be the program counter, and any one of which can be the 'data pointer'.

Two 4-bit registers hold the current 'data pointer' and program counter register numbers. The program counter (apart from being any one of sixteen registers) is quite normal in its operation. The 'data pointer' register is similar in some ways to a program counter — all memory transfers use it as the address of the memory to be accessed. The data pointer can be automatically incremented or decremented by some of the memory transfer instructions.

This sort of organisation makes subroutines simple to implement — the 4-bit designations of the program counter and data pointer register are changed. The same goes for interrupts. On interrupt, the processor stores the current register numbers in a 'temporary' 8-bit register, then uses register O as the program counter and register 1 as the data pointer — so that the interrupt subroutine address is stored in register O. A RETURN instruction sets the processor back to where it was before the interrupt.

All in all, it's quite a nice instruction set — not flashy, but certainly easy to comprehend.

There are four 'sense' lines to the processor — inputs directly to the chip which are accessible by special instructions. There is also an on-chip latch which can be software set and reset, whose output apears on one of the pins of the chip. This, and one of the 'sense' inputs, provides the cassette input and output for the VP-111.

All in all

The RCA COSMAC VP-111 is not an ideal beginner's machine — I wouldn't recommend it to a person with little knowledge of electronics. There are two reasons for this — the first is that some electronics knowledge is required just to get the machine up and running. The second reason is that the documentation provided with the VP-111 is not extensive enough in the 'lower end' (i.e: the beginner's end) to really provide a 'bootstrap' for the first-time user.

Having said that, I **do** think that it's a good machine for someone interested in micros who doesn't want to spend too much cash first up. It may also be of use to an engineer who has a specific application in mind — but probably with the addition of the VP-114 add-on (3K more memory and 8-bit parallel input and output).

The fully-fledged VIP system may also be worth a closer look.

Cromemco computers on the move

Adaptive Electronics of Melbourne are to move to larger and more centrally located premises at 418 St. Kilda Road, a move largely due to the company's rapidly expanding Cromemco computer division.

The facilities at St. Kilda Road include a larger showroom, offices, and a well-equipped service department. Together with the appointment of David Furst as field service engineer with customer liaison and support duties, this will enable faster response times to customer calls.

Adaptive Electronics has been marketing Cromemco computer systems since 1978 and provides complete hardware and software support for the products. Cromemco computer systems range from small floppy disk systems to multi-tasking 22M hard disk machines, and support a large range of system software including BASIC, FORTRAN, COBOL and an IBM-compatible RPG II.

As well as Cromemco products, AE also handles Tandon and Persci floppy disk drives, IMI Winchester hard disk drives, ZS systems memory boards and the Adaptabox range of instrument cases.

Adaptive Electronics can be contacted at 418 St. Kilda Rd, Melbourne Vic. 3004. (03)267-6800; telex AA32565.

CLUB CALL

Various computer users' clubs and societies have sent us updates on the information published in our last directory (ETI, Feb. 1981), so here it is:

The **Perth** members of the **Sorcerer Computer Users of Australia** meet on the first and third Monday of each month. Meetings are held in the Computer Building at the West Australian Institute of Technology, Hayman Road, Bentley. For information ring (09)367-6351 or write to 90 King George St, South Perth WA 6151.

Commodore Computer Users' Association of Victoria, GPO Box 5328 BB, Melbourne 3000, meets on the last Tuesday of each month in the library of Taylor's College, 114 Albert Rd, South Melbourne, at 7.30 pm. Telephone Mike de la Dette (VK3BHM) on (03)876-2989 for further information.

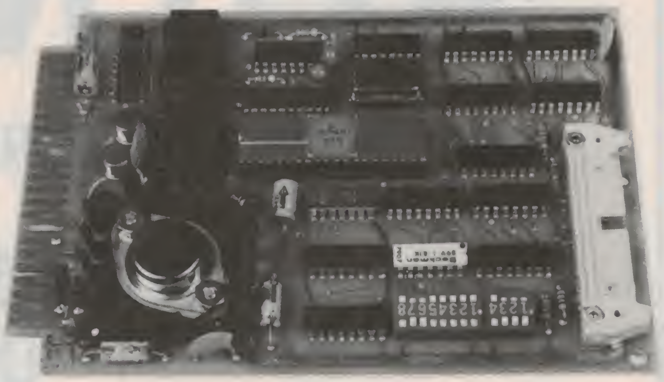
The Sorcerer Users' Group of South Australia (SUGSA) meets on the second Wednesday of each month at 7.30 pm on Level 1 of the Hughes Building, Adelaide University, North Terrace, Adelaide. Enquiries to the Secretary, Jeremy Webber, 22 Delange Ave, Banksia Park SA 5091.

The Exidy Sorcerer Users' Group in Victoria has a new address: Sorcerer Computer Users of Australia, PO Box 144, Doncaster Vic 3108. They meet on the first Sunday of every month at Monash University Zoology Lecture Theatre S7.

The Queensland Sorcerer Users' Group, c/- K.R. Saggers, Secretary, 43 Stubbs Rd, Woodridge Qld 4114, informs us that their committee has undergone the following changes: President — Geoff Snell; Vice President — Jim Myers; Secretary — Kelvin Saggers; Treasurer — Bob Baxter; Committee Member — Barry Watson.

The National Sinclair ZX80 Users' Club, c/- 24 Peel St, Collingwood Vic. 3066, offers tips and discussions, sample programs, programming tips — write for free introductory newsletter.

Any club with updated information is welcome to send it to us c/- Printout.



HDE Minidisk system for AIM and SYM

Energy Control of Queensland have just released the HDE Minidisk system for AIM-65 and SYM-1 microcomputers.

No longer bounded by long and unreliable cassette saves and loads, the HDE system allows the AIM or SYM to become the heart of a sophisticated system for program development or general use.

All transfers are verified for accuracy to ensure data has not been corrupted, and both software and hardware have been systems-engineered to produce a highly reliable system, according to Energy Control.

System software includes the HDE File Oriented Disk System and Text Editor, requiring only 8K for the operating system and overlay area. Systems-expanding programs available include the Text Output Processing System, Dynamic Debugging Tool and Comprehensive Memory Test, with more programs under development.

Hardware includes a KIM4-compatible 4½ x 6½ controller card which can plug into the 'Computerist' Mother Plus, and features a Western Digital 1771-based controller, TEAC FD50A drive, dual-drive power supply and cables.

Storage medium is the standard soft-sectored 5¼" minidisk; HDE have designed the system so that diskettes rotate only during disk transactions, thus extending media life. A disk formatter routine included within the system formats the diskette, verifies media integrity and checks drive rpm.

For more information contact Energy Control, P.O. Box 6502, Goodna Qld. 4300. (07)288-2757.

Apple II — where do you get it?

The Apple II, a popular machine — and no wonder, if you read Phil Cohen's review in the February issue — can be obtained from a host of dealers throughout the breadth of this fair land — according to information supplied by Electronic Concepts Pty Ltd, official distributors for Australia.

Herewith the host of Apple yards (er ... dealers) from whom you can obtain an Apple II, apart from Direct Computer Retail, who supplied the equipment reviewed.

New South Wales

Peter Hatcher
City Personal Computer
75 Castlereagh St,
Sydney 2000. (02)233-8992.

David Diprose
Computer Galerie
66 Walker St,
North Sydney 2060. (02)929-5497.

Kent Jenkins
Coleman Pye Pty Ltd
142-144 Darling St,
Dubbo 2830. (068)82-3266.

Mike Jones
Coleman Pye Pty Ltd
98-100 Keppel St,
Bathurst 2795. (063)31-1966.

Greg Bennett
Coleman Pye Pty Ltd
109 Bridge St,
Tamworth 2340. (067)65-7555.

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Parry's Office Supplies
25 Molesworth St,
Lismore 2480. (066)21-7331.

Victoria

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Computer Country Pty Ltd
338 Queen St,
Melbourne 3000. (03)329-7533.

Brian Meehan
Comshare Computer Corp.
608 Station St,
Box Hill 3128. (03)89-0341.

Colin Sparks
Metropolitan Business Machines
338-342 Sydney Rd,
Coburg 3058. (03)383-2222.

Peter Janssen
Mildura Office Equipment
91 Langtree Ave,
Mildura 3500. (050)23-3611.

Wilson McOrist
Ram Computer Aid Pty Ltd
103C Murphy St,
Wangaratta 3677. (057)21-6443.

Tony Witlox
Witlox Office Supplies
100 Nixon St,
Shepparton 3630. (058)21-7011.

Queensland

John Badford
South Coast Office Machines
12 Davenport St,
Southport 4215. (075)32-2722.

Graham Basford
Specialty Business Equipment
33 Howard St,
Nambour 4560. (071)41-1851.

Bob Catterall
Mackay Office Equipment
6 Keats St,
Mackay 4740. (079)57-2777.

Frank Norman
Northern Business Equipment
237 Charters Towers Rd,
Hermit Park 4812. (077)79-4944.

South Australia

John Morrisey
South East Business Machines
54 Gray St,
Mt Gambier 5290. (087)25-8906.

Northern Territory

Mike Sandeman TV Rentals
6 Priest St,
Alice Springs 5750. (089)52-2436.

ACT

Ron Bland
ACT Office Equipment
11 Kembla St,
Fyshwick 2609. (062)80-4710.

SOLAR PANELS — SPECIAL OFFER TO READERS OF ETI.

AMTEX ELECTRONICS, solar energy specialists, have available a number of *mil-spec.* solar panels that they are willing to offer to readers of ETI at a special price. These panels, type MB 4310, were manufactured by Sensor Technology (now called Photowatt International Inc.) for a military order and have the characteristics listed below:

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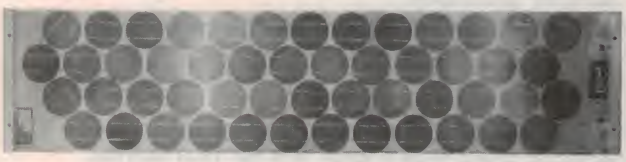
Current at peak power:	1.2 A
Peak power output:	24 Watt (Measured at a light intensity of 100 mW/cm^2 and 24°C)
Electrical insulation to substrate:	2000 Vdc minimum

MECHANICAL DATA

Nominal outside dimensions:	1220 x 290 x 22 mm
Nominal weight:	9 kg
Hail storm:	Hailstones up to 30 mm dia.
Wind loading:	190 km/h
Storage temperature:	−40 to +80 °C



SPECIAL PRICE — $399

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This price includes waterproof connector sockets. There are only a limited number of panels, so be early. Offer closes 29 May, 1981.

NOTE: This offer is made by Amtex Electronics and ETI is acting as a clearing house for orders only. Cheques should be made payable to **Amtex Solar Panel Offer** *and sent to* **"Solar Panel Offer"**, *ETI Magazine, 15 Boundary St, Rushcutters Bay NSW 2011. We will then process your order and pass it on to Amtex, who will send you the goods. Please allow up to four weeks for delivery. Offer expires on 29 May, 1981.*

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OPTIONAL ACCESSORIES

User Guide — additional information for the beginner and the newcomer to CHIP-8. Recommended.

Expansion Kit — extra RAM, and full expansion facilities enabling the use of the following:

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Quadraphonic Expander Board	Tiny BASIC (Integer)
ASCII/Numeric Keyboard	Floating Decimal Point BASIC (16K!)

Colour Board (PAL) and Interactive Data Terminal — coming soon. Software — The U.S. User Group has already gathered hundreds of programmes, applications and hardware ideas. Several books have been published, in addition to RCA's own manuals.

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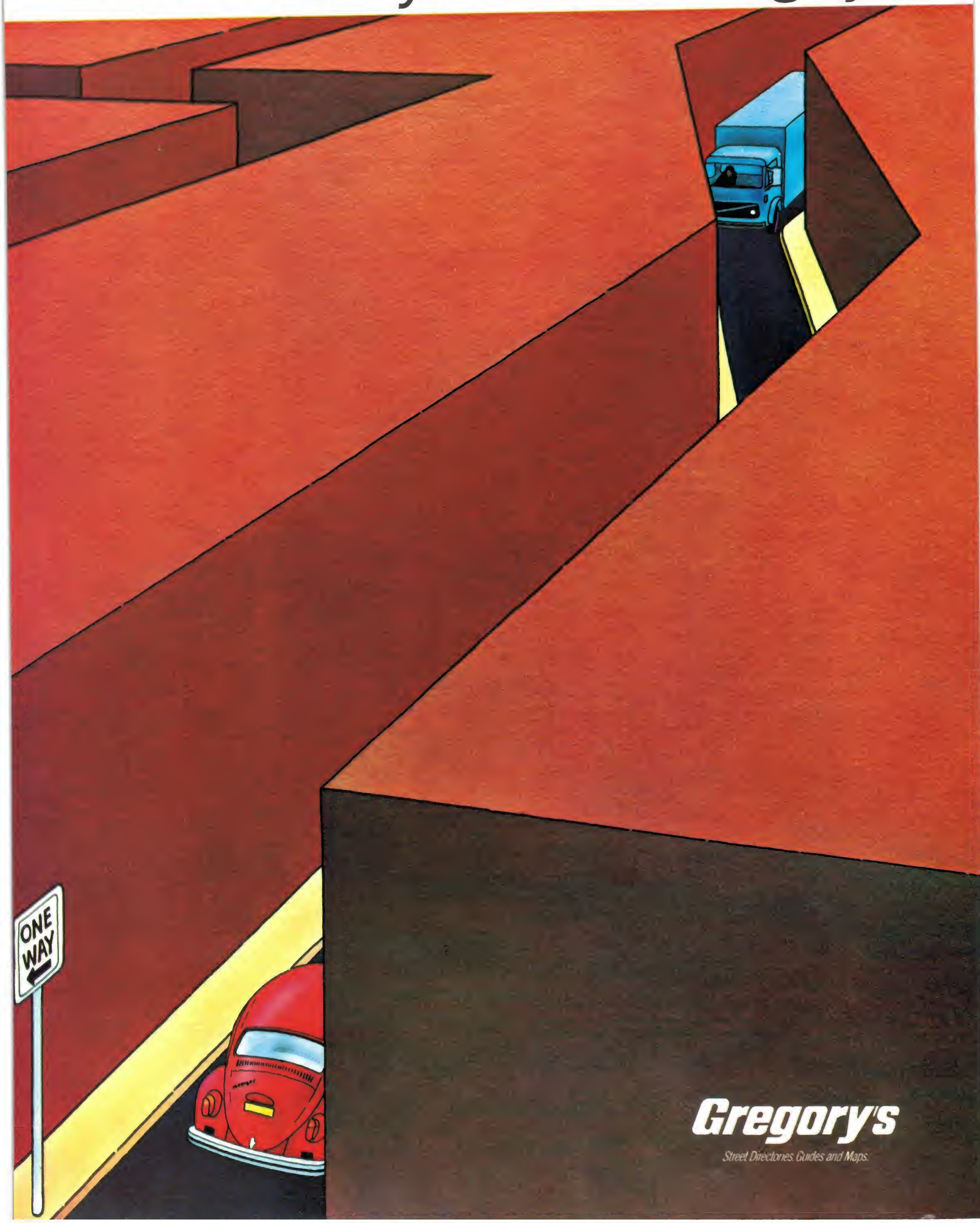

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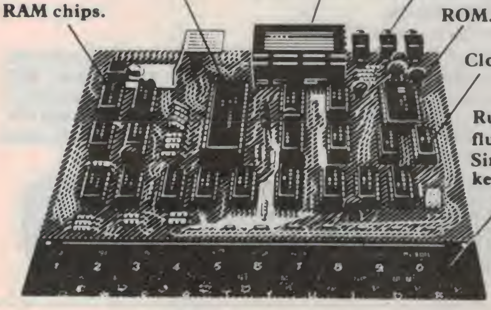

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POKEing on the ZX80

M.E. Bryant

Here are some useful tips for owners of this popular little low-cost micro, showing how to make screen POKEs.

Of the design compromises which allowed Sinclair to produce a high-level language microcomputer selling for under $300 here, perhaps the most noticeable is the lack of a memory-mapped display with separate video control, resulting in the now infamous screen-flicker on data entry and the absence of any display during computations.

The absence of a memory-mapped display can be a nuisance, especially for the writer of games programs, as one of the most interesting things one is able to do is to PEEK at individual screen locations and to POKE characters directly on to the screen. Animated graphics, of course, depend on this facility, but they are definitely **out** with the ZX80 because the screen would remain blank while the action was being computed. On the other hand, using POKE to put characters on to the screen is feasible and is potentially a useful feature.

Filing a display

With a memory-mapped display there is no problem because the display file is contained within a fixed amount of RAM. The screen can be considered to consist of a matrix of locations (number of lines by number of characters per line) with the memory address of each one fixed and known. To make a character appear at any desired point on the screen it is simply a matter of POKEing the code for that character at the relevant location address.

On the ZX80 things are rather different. The display-file uses a variable amount of RAM depending on the quantity of data to be displayed. The addresses of the various locations on the screen also vary according to the length of the program. In addition, the location addresses change during the running of a program whenever data is input for the first time or variables are assigned.

The computer, of course, knows where the display-file is in the RAM at any time and the address of the start of the display-file is recorded as a two-byte record at address 16396. By PEEKing at that address we can locate the display-file and then calculate the addresses where we need to POKE to get characters on to the screen.

Character by character

The first character in the display-file is a "newline" character, so that if we call the address of the start of the display-file W then the first visible character location (top left) is at W + 1. Each line consists of up to 32 visible characters with a newline character at column 33. By adding the appropriate multiple of 33 plus the column number to W we can get the address of any character location on the screen. If we call the row number A and the column number B then the address formula is W + (A−1)*33 + B.

Of course the display-file has to exist before we can start PEEKing and POKEing at it. If we wish to POKE on to a blank screen then it is first necessary to create a display-file full of spaces. Unfortunately a succession of PRINT statements will not achieve this and although a FOR..NEXT loop PRINTing individual spaces will, it is very cumbersome. Luckily PRINT,,,, creates a line full of spaces so a short loop can be used to produce the required number of screen lines. Obviously characters can be used as well as spaces to create a display-file. Up to 23 lines can be printed in this way.

Having ensured that we have a display-file we can now take a PEEK at its starting address. The following subroutine achieves this and it is used in all subsequent listings:-

```
500  LET P = PEEK(16397)
510  IF P>127 THEN LET P = R-256
520  LET W = PEEK(16396) + P*256
530  RETURN
```

It should now be obvious how we can use this address to POKE a character on to the screen. The following program establishes a blank display-file, inputs a row and column number, POKEs character code 148 (inverse asterisk) at the relevant address and then inputs another "grid reference". When the program is run, inverse asterisks appear at your bidding anywhere on the screen:-

```
 10  LET P = 0
 20  LET W = 0
 30  FOR A = 1 TO 22
 40  PRINT ,,,,
 50  NEXT A
 60  INPUT A
 70  INPUT B
 80  IF A>22 OR B>32 THEN GOTO 60
 90  LET Y = (A-1)*33 + B
100  GOSUB 500
110  POKE W + Y, 148
120  GOTO 60
500  LET P = PEEK(16397)
510  IF P>127 THEN LET P = P-256
520  LET W = PEEK(16396) + P*256
530  RETURN
```

The following two alterations to the listing extend this simple program:-

Specify character to be POKEd:-

```
 84  INPUT C
110  POKE W + Y,C                 (C is relevant character code)
```

POKE character taken from the keyboard:-

```
 84  INPUT C$
 86  LET X = CODE(C$)
 88  IF X>191 THEN GOTO 84
110  POKE W + Y,X
```

It will be noticed that the programs above assign variables P and W before the first PEEK. This is because, as mentioned before, any variable assignment or initial input will alter the location of the display file. If you write any screen-POKE programmes and find that the characters are displaced it will amost certainly be because a variable in either PEEK or POKE has not been previously assigned. A similar case is where an initial input or an assignment is made after a previous PEEK or POKE, when it will be necessary to take another PEEK at W before POKEing again.

Careful POKEs

Another thing worth remembering is that POKEing can be a hazardous occupation if you happen to POKE in the wrong place or even if you POKE an inappropriate character code in the right place. Care should therefore be taken when writing programs to ensure that characters are not POKEd outside the boundaries of the display-file. Usually such characters seem to disappear without trace but sometimes they can find their way into your program, invariably with unpleasant consequences. Some bad POKEs can cause havoc with the video control. The codes for all statements, tokens and operators should **definitely** be avoided (i.e: codes >191).

A more subtle problem is that any extensive use of screen space is very expensive in terms of memory. A 23-line "blank" screen will occupy 760 bytes of RAM, which does not leave much for the program if you are using the basic model ZX80 with 1K of memory. You therefore need to think hard about the balance of memory requirement when writing screen-POKE programs if you have no memory expansion.

Having grasped the principles involved in defining and locating the display-file it is relatively simple to manipulate it. Existing characters on the screen can be replaced by POKEing an alternative code at the same address. If this is the code for a space (0) then the character already on the screen disappears. By PEEKing at the address you plan to POKE to you can see what character already occupies that location, thus opening up the possibility of a conditional response. All the relevant character codes are identified in the ZX80 handbook.

More ZX80 POKEing next month.

Uncovering the Z80

Holmes and Watson would have been proud of the logic displayed in this investigation of one of computing's dark secrets.

THE Z80 is generally recognised as being just about the most powerful eight-bit micro around, and it's used in personal computers such as the TRS-80, the NASCOM and the Sharp MZ-80K. Zilog's literature for the Z80 describes its repertoire of 158 types of instruction, with a total of 696 possible opcodes (plus data).

You may think that this should be enough for anyone, but it's actually possible to find, on most Z80s, 88 more usable opcodes. These effectively give you access to four extra eight-bit registers; the more machine-code programming you do, the more you'll appreciate that you can't have too many registers.

This article explains what these instructions are and why they exist. It also gives a program which will test the Z80 in a TRS-80 to see if it possesses them.

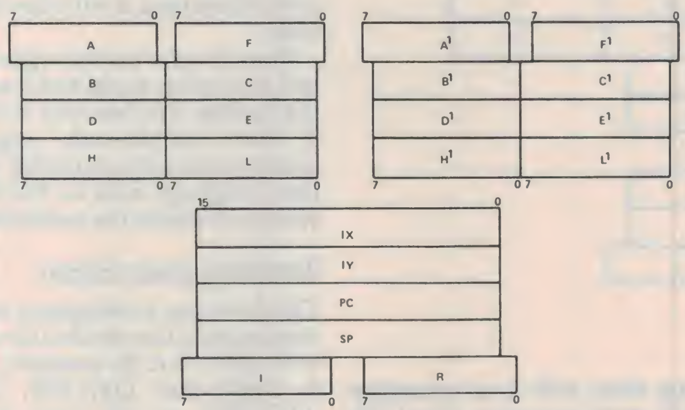

Figure 1. **What the Z80 looks like inside according to the manuals.**

Z80 architecture

To start, though, let's remind ourselves of the Z80's architecture. Figure 1 is a diagram of the micro.

The device has two sets of working registers, each set comprising a single accumulator (A), a flags register (F) and six general-purpose eight-bit registers (B-L); the six registers can be combined into three 16-bit registers. The micro has instructions to select the register set in use at any time.

The Z80 also has the usual program counter (PC) and stack pointer (SP), and two 16-bit index registers (IX and IY). We won't bother with I and R on Figure 1 here.

The Z80 is a development of the Intel 8080A, from which it inherits the A-L registers. The second set of registers A^1-L^1) aren't in the 8080A, which also lacks IX and IY.

As well as the extra hardware, the Z80's designers also managed to cram in a lot more instructions. The Z80 can perform all the earlier micro's instructions, using the same opcodes, and has many more of its own. The extra instructions cover features such as bit testing, relative jumps, register shifts and block moves of data. Most importantly, as far as this article is concerned, they also provide a comprehensive set of indexed instructions.

These help to get round a curious limitation of the 8080A, inherited by the Z80, which is that a lot of references to memory have to use the register pair HL as a pointer. This sometimes leads to clumsy programming. For instance, to add the contents of address 1234H to the accumulator, we have to use:

```
LD    HL,1234H    ;HL=1234H
ADD   A,(HL)      ;A=A + DATA
```

The Z80 extends this type of addressing in order to have an indexing capability.

Indexed addressing

If you look at a description of the Z80's assembly-language, you'll soon see (I hope) something interesting about the way the micro does its indexing. Whenever an instruction has a form using (HL), it also has an indexed form. Thus we have:

```
LD    A,(HL)   LD    A,(IR+d)
BIT   7,(HL)   BIT   7,(IR + d)
```

I'm using 'IR' to represent 'IX or IY'. Furthermore, there are no indexed instructions which do not have (HL) counterparts.

I hope the suspicion is now growing that the two index registers and HL are closely related. This suspicion becomes a certainty when we look at the machine code which the micro actually executes.

For example, the Hex code to perform 'ADD A,(HL)' is 84; the equivalent code for 'ADD A,(IX + d)' is DD 84 dd, where 'dd' is the displacement expressed in two's complement form.

To take another example, the Hex code for 'BIT 7,(HL)' is CB 7E, and that for 'BIT 7,(IY + d)' is FD CB 7E dd. If you study your list of Z80 instructions (if you haven't got one, you shouldn't be reading this article!) you will see a remarkable consistency. Every (IX + d) instruction has an opcode formed by prefixing the equivalent (HL) command by 'DD', and adding 'dd' to the end. The (IY + d) commands are formed by using an 'FD' rather than 'DD' prefix.

This observation also partly explains why indexed instructions execute more slowly than their (HL) counterparts — the opcodes are two bytes longer. Reading the extra bytes takes time.

From this sort of evidence, I'm pretty certain that the Z80 uses the same internal logic to decode (HL) and (IR + d) instructions. The actual register selected is defined by the instruction's prefix, or lack of one.

Possibility of extra instructions

Having seen how the Z80 gets at its indexed instructions, an interesting possibility arises. So far, we've only considered HL as a 16-bit register, but it can, of course, be treated as two eight-bit registers. What happens if we take, say, the opcode for 'LD A,H' and prefix it with DD?

When I do it to the Z80 in my TRS-80, I find, amazingly enough, that A is loaded with the high byte of IX. No other registers have been altered. Lo and behold! I have an extra instruction. Obviously, it goes a lot further, or else I wouldn't be writing this!

On all the Z80s I've checked, the close relationship between HL, IX and IY allows each of the index registers to be treated for many purposes as two eight-bit registers. ▶

Since, in general terms, you can't have too many internal registers in a micro, this is potentially a very valuable discovery. Its usefulness obviously depends on whether or not you're using the index registers as index registers, but it gives an extra two eight-bit registers for each index register you can spare.

Extra instructions available

Let's have a look now at just what we can do with our extra registers. First of all, some nomenclature — I'll call the two bytes of IX 'XH' and 'XL', and the two bytes of IY 'YH' AND 'YL' (Figure 2). With these register names, we could, in the example above, use the mnemonic 'LD A,XH' for the instruction with the opcode DD 7C.

When I first discovered these extra commands, I hoped that XH etc. could be used in *any* Z80 operation that used H or L. For instance, we could have 'LD YL,B', 'SUB YH', 'CP XH', 'BIT 3,YL', etc. Unfortunately, the Z80 does not seem to work quite that way.

whether 'DD 6B' meant 'LD XL,H' or 'LD L,XH'; it actually settled on 'LD XL,XH'. So we cannot mix H or L with the extra registers in a single operation.

The second limitation is more obscure — i.e: I don't know why it exists! The extra registers will only work in the operations inherited from the 8080A, and not in the 'new' Z80-only instructions. As far as I can see, the difference is related to the fact that all the 8080A-compatible instructions use single-byte opcodes (plus data if it's appropriate), while the Z80 specials all use two bytes. Whatever the reason, it means that you can't use BIT, SET, RES, rotates or shifts. Still, the extra commands are free, so we can't complain.

Table 1 shows all the 'extra' instructions which are possible. It does not give their opcodes — you can form these by using the 'DD' and 'FD' prefixes as appropriate.

A small word of warning. I've shown the extra commands in the standard Z80 mnemonic format. However, it's no

Mnemonic	Test Segment
LD r,XR	LD1
LD XR,r	LD2
LD XR,data	LD3
LD XR1,XR2	LD4
ADC A,XR	ADDSUB
ADD A,XR	ADDSUB
SBC A,XR	ADDSUB
SUB XR	ADDSUB
INC XR	INCDEC
DEC XR	INCDEC
AND XR	ANDORX
OR XR	ANDORX
XOR XR	ANDORX
CP XR	COMP

Notes:
'r' — Register A,B,C,D or E
'XR' — 'Register' XH,XL,YH or YL
'XR1', 'XR2' — Any XR
The mnemonics follow the usual Z80 conventions

Table 1. Extra instructions available.

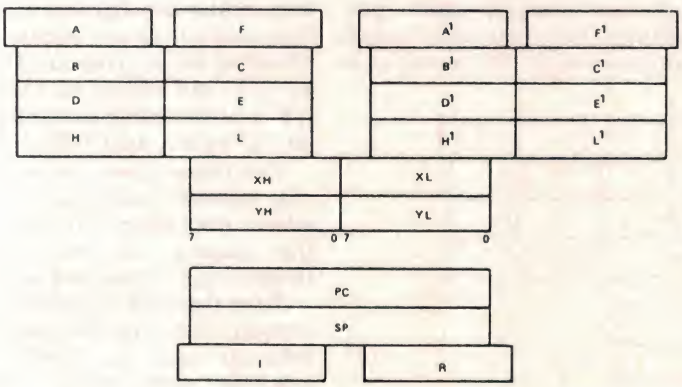

Figure 2. **What the Z80 might look like inside if you are lucky.**

In the first place, it's not possible to have, for example, 'LD XL,H'. This is not too surprising. The instruction would be generated by prefixing the code for 'LD L,H' (i.e: 6B) with DD. However, the micro would not know

use trying them with your assembler, because it won't recognise them! You must either write a new assembler, or resort to hand coding.

It's important to remember that these extra instructions are 'unsupported'. That is to say, they don't appear in the official Z80 literature, and so there is no guarantee that every Z80 will execute them successfully. It may well be that, at some stage, Zilog will modify the micro's internal workings, and the change will stop it responding to these commands. Obviously, if a given chip obeys them once, it will obey them every time.

If you want to use them then you must test your micro to see how it responds to the opcodes. The best way is via a series of short machine-code program segments, preferably controlled via a high-level language such as BASIC so that you can evaluate the results easily.

Testing your micro

The first step in designing such a self-test program is to decide just what needs to be done. Is it, for example, necessary to check that 'LD A,XH', 'LD B,XH', 'LD C,XH', etc. *all* work properly? I think not. If we can show that, say, XH can be loaded into B, then it's virtually certain that it can be loaded into A, C, D and E also. It *is* worth checking that ▶

```
00100  ;ROUTINE TO CALL EACH TEST SEGMENT
00110  ;
00120  TSTALL   CALL  0A7FH        ;READ HL
00130           LD    A,75H        ;A=75H
00140           LD    C,A
00150           LD    B,A          ;BC=7575H
00160           LD    D,A
00170           LD    E,A          ;DE=7575H
00180           CALL  7C45H        ;PERFORM TEST
00190           LD    (7C04H),BC   ;SAVE BC
00200           LD    (7C06H),DE   ;SAVE DE
00210           LD    (7C08H),IX   ;SAVE IX
00220           LD    (7C0AH),IY   ;SAVE IY
00230           LD    (7C02H),A    ;SAVE A
00240           JP    0A9AH        ;RETURN - PASS BACK HL
00250
```

Program 1. 'TSTALL'

```
00260  ;TEST THE 'LD R,XR' INSTRUCTIONS
00270  ;
00280  LD1      LD    IX,1234H     ;IX=1234H
00290           LD    IY,5678H     ;IY=5678H
00300           LD    B,XL
00310           LD    C,YH         ;BC SHOULD = 3456H
00320           LD    D,YL
00330           LD    E,XH         ;DE SHOULD = 7812H
00340           LD    A,XH         ;A SHOULD = 34H
```

```
                RET

        TEST THE 'LD XR,R' INSTRUCTIONS

LD2     LD      BC,2345H        ;BC=2345H
        LD      DE,7890H        ;DE=7890H
        LD      XH,C
        LD      XL,D            ;IX SHOULD = 4578H
        LD      YH,A
        LD      YL,E            ;IY SHOULD = 7590H
        RET

        TEST THE 'LD XR,DATA' INSTRUCTIONS

LD3     LD      IX,0            ;IX=0
        LD      IY,0            ;IY=0
        LD      XH,17H
        LD      XL,23H          ;IX SHOULD = 1723H
        LD      YH,0F0H
        LD      YL,8BH          ;IY SHOULD = 0F08BH
        RET

        TEST THE 'LD XR1,XR2' INSTRUCTIONS

LD4     LD      IX,64H          ;IX=0064H
        LD      XH,XL           ;IX SHOULD = 6464H
        LD      IY,3700H
        LD      YL,YH           ;IY SHOULD = 3737H
        RET

        TEST THE ARITHMETIC INSTRUCTIONS

ADDSUB  LD      A,90H           ;A=90H
        LD      IX,8020H        ;IX=8020H
        LD      IY,4030H        ;IY=4030H
        ADD     A,XH            ;SHOULD BE: A=10H, CY=1
        ADC     A,XL            ;SHOULD BE: A=31H, CY=0
        SUB     YH              ;SHOULD BE: A=0F1H, CY=1
        SBC     A,YL            ;SHOULD BE: A=0C0H
        RET

        TEST THE 'INC & DEC' INSTRUCTIONS

INCDEC  LD      IX,OFFH         ;IX=OOFFH
        LD      IY,OFFOOH       ;IY=FFOOH
        INC     XH
        INC     XH
        DEC     XL              ;IX SHOULD = 02FEH
        DEC     YH
        DEC     YH
        INC     YL              ;IY SHOULD = FD01H
        RET

        TEST THE 'LOGICAL' INSTRUCTIONS

ANDORX  LD      IX,OB51CH       ;IX=OB51CH
        LD      IY,96D4H        ;IY=96D4H
        LD      A,O             ;A=O
        OR      XH              ;A SHOULD = B5H
        AND     YL              ;A SHOULD = 94H
        XOR     XL              ;A SHOULD = 88H
        RET

        TEST THE COMPARISONS

COMP    LD      IX,1234H        ;IX=1234H
        LD      IY,5678H        ;IY=5678H
        LD      A,34H           ;A=34H
        CP      XH              ;A=XH?
        RET     Z               ;RETURN IF ERROR
        LD      A,56H           ;A=56H
        CP      YH              ;A=YH?
        RET     Z               ;SHOULD RETURN FROM HERE
        LD      A,10H           ;SET ERROR CODE
        RET                     ;ONLY HERE ON ERROR
        END
```

Program 2. Test segments

```
10   REM TEST Z80 EXTRA INSTRUCTIONS
20   FL=-1: REM FL IS PASS/FAIL FLAG
30   CLS: PRINT @15, "TEST Z80 EXTRA INSTRUCTIONS":
40   POKE 16526,32:POKE 16527, 124:REM USR START POINT
50   FOR I=31776 TO 31809:READ B:POKE I,B:NEXT:REM LOAD TSTALL
60   REM START TESTING
70   FOR I=1 TO 8
80   READ IT,J1,J2,J3,J4,J5,F$:REM EXPECTED RESULTS AND CONTROL
     DATA
90   FOR I2=31813 TO 31812+IT:READ B:POKE I2,B:NEXT:REM LOAD TEST
     SEGMENT
100  HL=USR (12345):REM RUN TEST
110  GOSUB 1000:REM RECOVER REGISTERS
120  IF A=J1 AND BC=J2 AND DE=J3 AND HL=12345 AND IX=J4 AND
     IY=J5 THEN GOSUB 2000 ELSE GOSUB 3000
130  NEXT I
140  IF FL THEN PRINT@841, "TESTS OF EXTRA INSTRUCTIONS
     SUCCESSFUL"; ELSE PRINT@842, "TESTS OF EXTRA INSTUCTIONS
     FAILED";
150  END
1000 REM RECOVER REGISTERS
1010 REM A : 7C02H : 31746
1020 REM BC : 7C04H : 31748
1030 REM DE : 7C06H : 31750
1040 REM IX : 7C08H : 31752
1050 REM IY : 7C0AH : 31754
1060 A=PEEK(31746)
1070 BC=256*PEEK(31749)+PEEK(31748)
1080 DE=256*PEEK(31751)+PEEK(31750)
1090 IX=256*PEEK(31753)+PEEK(31752)
1100 IY=256*PEEK(31755)+PEEK(31754)
1110 RETURN
2000 REM SUCCESS MESSAGE
2010 PRINT@I*64,F$;:PRINT@I*64+8,"SATISFACTORY";
2020 RETURN
3000 REM SUBROUTINE TO PRINT ERROR INFORMATION
3010 PRINT@I*64+32,F$;:PRINT@I*64+40,"FAILED";:FL=0:REM SET
     BASIC MESSAGE AND FLAG
3020 PRINT@640,"FAILURE REPORT FOR SEGMENT";F $
3030 PRINT "REGISTERS:"TAB(19)"A" TAB(24)"BC" TAB(31)"DE" TAB(38)
     "HL" TAB(45)"IX" TAB(52)"IY"
3040 PRINT "SHOULD HAVE BEEN:" TAB(16)J1; TAB(22)J2, TAB(29)J3,
     TAB(36)12345; TAB(43)J4, TAB(50)J5
3050 PRINT "WERE:" TAB(17)A; TAB(22)BC; TAB(29)DE; TAB(36)HL,
     TAB(43)IX; TAB(50)IY
3060 PRINT@965, "PRESS 'A' TO ABANDON; PRESS 'C' TO CONTINUE";
3070 IN$=INKEY$: IF IN$="" THEN 3070
3080 IF IN$="A" END
3090 IF IN$="C" PRINT@640,STRING$(191," ");: PRINT@832,STRING$
     (191," ");:RETURN
3100 GOTO 3070
4000 REM CALLING ROUTINE
4010 DATA 205, 127, 10, 62, 117, 79, 71, 87, 95, 205, 69, 124, 237, 67, 4, 124,
     237, 83
4020 DATA 6, 124, 221, 34, 8, 124, 253, 34, 10, 124, 50, 2, 124, 195, 154, 10
4030 REM LD1
4040 DATA 19, 52, 13398, 30738, 4660, 22136, LD1
4050 DATA 221, 33, 52, 18, 253, 33, 120, 86, 221, 69, 253, 76, 253, 85, 221, 125,
     201
4060 REM LD2
4070 DATA 15, 117, 9029, 30864, 17784, 30096, LD2
4080 DATA 1, 69, 35, 17, 144, 120, 221, 97, 221, 106, 253, 103, 253, 107, 201
4090 REM LD3
4100 DATA 21, 117, 30069, 30069, 5923, 61579, LD3
4110 DATA 221, 33, 0, 0, 253, 33, 0, 0, 221, 38, 23, 221, 46, 35, 253, 38, 240, 253,
     46, 139, 201
4120 REM LD4
4130 DATA 13, 117, 30069, 30069, 25700, 14135, LD4
4140 DATA 221, 33, 100, 0, 221, 101, 253, 33, 0, 55, 253, 108, 201
4150 REM ADDSUB
4160 DATA 19, 192, 30069, 30069, 32800, 16432, ADDSUB
4170 DATA 62, 144, 221, 33, 32, 128, 253, 33, 48, 64, 221, 132, 221, 141, 253,
     148, 253, 157, 201
4180 REM INCDEC
4190 DATA 21, 117, 30069, 30069, 766, 64769, INCDEC
4200 DATA 221, 33, 255, 0, 253, 33, 0, 255, 221, 36, 221, 36, 221, 45, 253, 37,
     253, 37, 253, 44, 201
4210 REM ANDORX
4220 DATA 17, 136, 30069, 30069, 46364, 38612, ANDORX
4230 DATA 221, 33, 28, 181, 253, 33, 212, 150, 62, 0, 221, 180, 253, 165, 221,
     173, 201
4240 REM COMP
4250 DATA 21, 86, 30069, 30069, 4660, 22136, COMP
4260 DATA 221, 33, 52, 18, 253, 33, 120, 86, 62, 52, 221, 188, 200, 62, 86, 253,
     188, 200, 62, 16,201
```

Program 3. Program listing for the BASIC controller.

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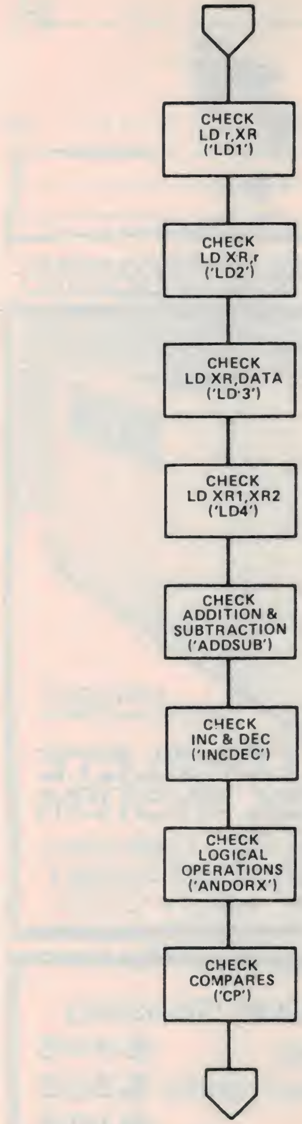

Figure 3. **Flowchart for the checking operations to find out if your Z80 has the 'added-extra'.**

each extra register can be loaded successfully into a normal register.

It is convenient for the program to check the extra instructions in logically-related blocks; I suggest that we can use the eight blocks shown in Table 1. Figure 3 shows the test sequence, which goes from the 'simpler' instructions to the 'more complex' ones.

Each block tests a suitable selection of the possible operations, and must do two things: it has to make sure that the extra operations work, and it has to check that the 'unused' registers are not corrupted. I decided that the best way to achieve these was to use a standard machine-code subroutine, which would call the test segments proper one at a time.

Before each test, all the registers in the micro would be set to known values and, at the end of the test, they would all be saved in memory. The high-level, controlling program (in BASIC) could then recover the stored data and test it for correctness before the next test.

Program 1 on page 88 is an assembly-language listing for this controlling subroutine ('TSTALL'), and Program 2 on pages 88-89 shows the eight test segments. All are written to suit a TRS-80 (Level II, 16K). Each segment is fairly simple, but a few comments are probably in order.

TSTALL. This segment starts with a 'CALL 0A7FH', and ends with 'JP 0A9AH'. These are the TRS-80 routines which pass the value of HL between BASIC and machine-code, via USR — by using these, I did not have to use TSTALL to store HL in memory.

This segment also uses a 'CALL7C45H' to get to each test segment; as we will see later, each is loaded, in turn, into the same area of RAM by the BASIC program. If the subsequent 'RET' goes wrong, then we know that SP has been corrupted by the tests.

ADDSUB. This segment tries each of the four eight-bit arithmetic operations once. I chose the values and the sequence of using them so that, as far as possible, multiple errors were unlikely to cancel each other out.

COMP. When we test the 'CP's, we have to make sure that the Z flag is set/reset at the right times. The 'LD's of A are arranged so that, if things go wrong, the segment exits with the wrong value in A.

Those, then, are the fundamental machine-code tests. To control them, however, I used a BASIC program, which made it much easier to assess the results and to format the output. The program has to do several things:

a. Load the appropriate machine-code segments.
b. Run the machine code.
c. Evaluate the results.
d. Output its assessment.

Program 3 on page 89 is a listing of the program that I used.

Initially, the calling routine is loaded into the top of memory by a series of READs and POKEs, and then the tests proper start.

The first line of DATA for each test segment defines the number of bytes in the subroutine, the expected values in all the registers except HL (which should always be 12345), and the title of the segment. This data allows the test segment to be loaded and run.

The actual values of the registers, saved in memory by 'TSTALL', are recovered by the subroutine at lines 1000-1100, and the result is evaluated. If the results are OK, a suitable message is printed, and the program goes on to the next test.

If any failure occurs, the subroutine at line 3000 is called. This prints out an error message, and the expected and actual data in the registers. The routine also clears a flag (FL) to show that there was a fault. Finally, the fault routine sits in a loop while you make up your mind what to do next.

Figure 4 shows the sort of display which might appear partway through the test of a Z80 which does not respond properly. You'll notice that I have to modify the 'expected' values to force a failure. At the end of the test, a success/failure message appears.

The only other point to watch out for when you run this program on a TRS-80 is the protection of the RAM used for the machine-code. There's probably no threat to it, but you should answer the 'MEMORY SIZE?' prompt with 31734 to be safe.

Use on other micros

The program here runs on a TRS-80. What, you may ask, do you have to do to run it on, say, an MZ-80K?

Obviously, the BASIC and the actual addresses used must be changed to suit the new machine. However, the critical parts of the program, the eight test segments, are all relocatable (they don't use absolute addresses), and so they shouldn't need any attention. You will have to massage 'TSTALL' a bit to suit how, or if, you pass the value of HL through a USR.

Conclusion

Most, if not all, Z80s have extra instructions in them which Zilog is very coy about. These instructions give the dedicated machine-code masochist four extra eight-bit general-purpose registers to play with, and can be very useful indeed.

It's very easy to test whether or not your micro has these commands. If it has, you've got an unexpected bonus, and if it hasn't — you never knew you were missing them. ●

```
            TEST Z80 EXTRA INSTRUCTIONS

LD1     SATISFACTORY
LD2     SATISFACTORY
                        LD3     FAILED
LD4     SATISFACTORY
ADDSUB SATISFACTORY
                        INCDEC FAILED

FAILURE REPORT FOR SEGMENT INCDEC
REGISTERS:  A     BC     DE     HL     IX    IY
SHOULD
HAVE BEEN: 117   32369  30069  12345  766   64769
WERE:      177   30069  30069  12345  766   64769

  PRESS 'A' TO ABANDON: PRESS 'C' TO CONTINUE
```

Figure 4. **A typical failure output.**

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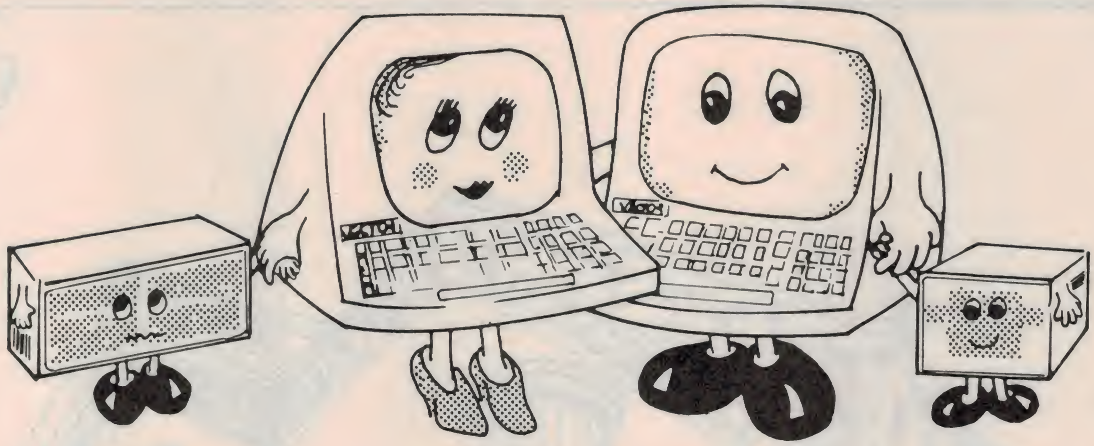

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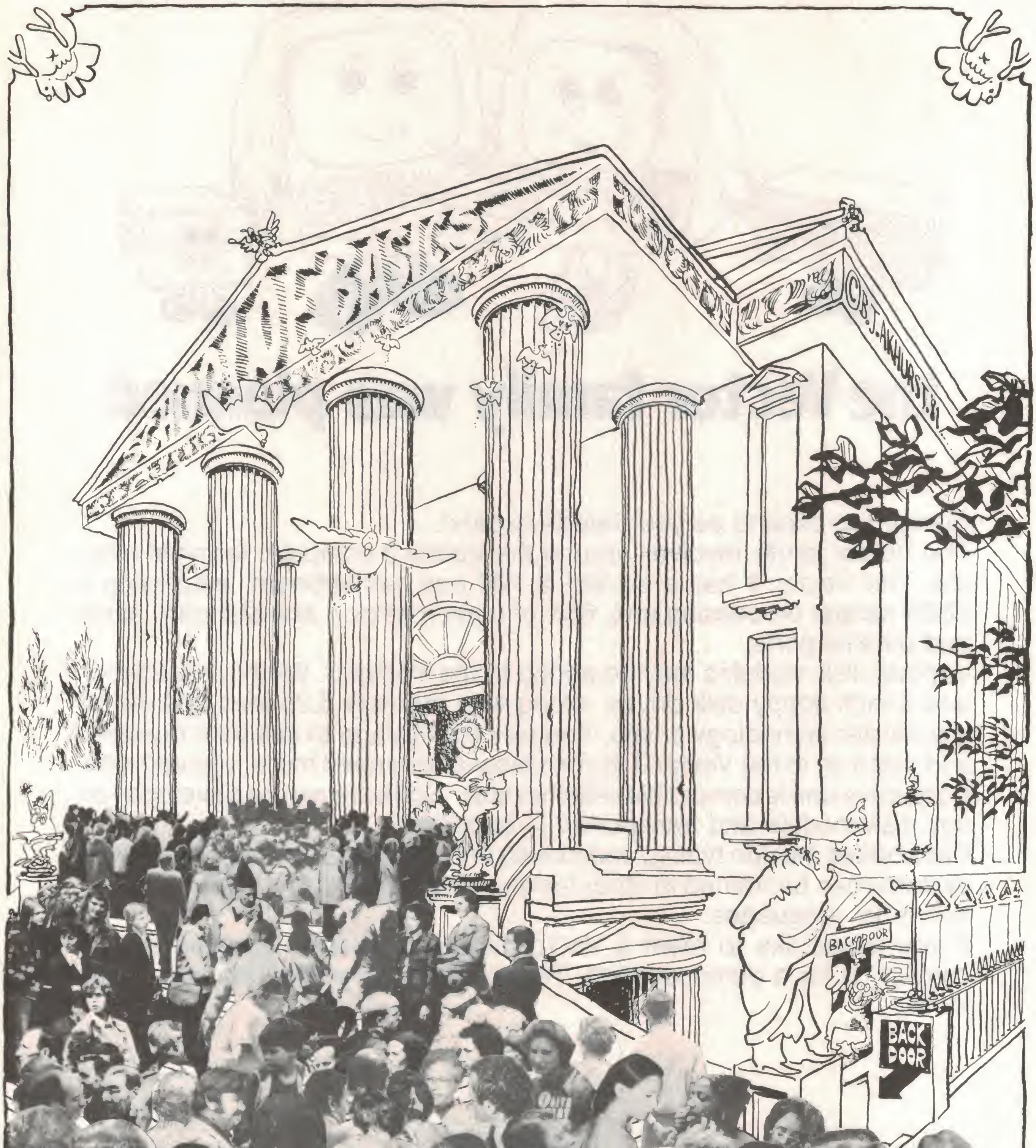
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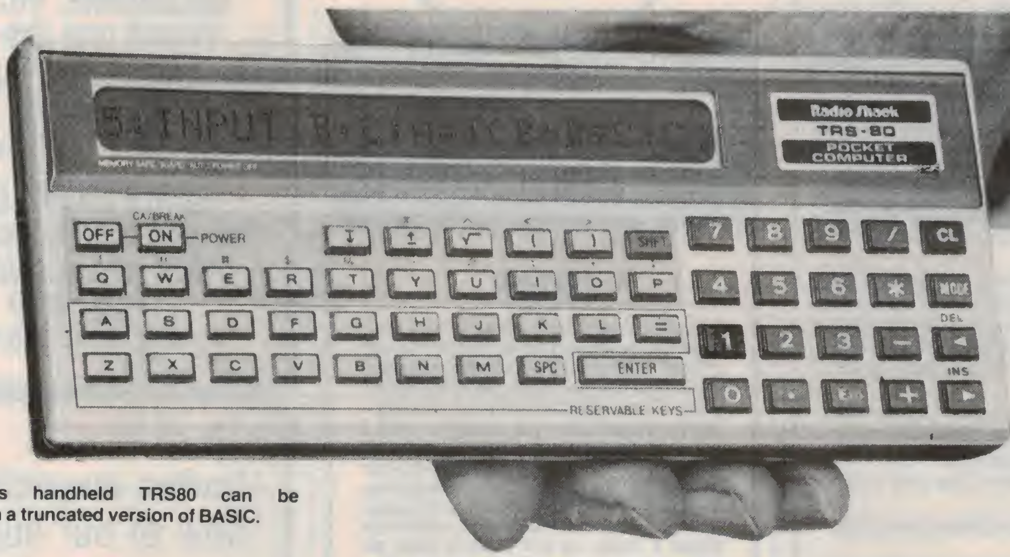

Even Tandy's handheld TRS80 can be programmed in a truncated version of BASIC.

Part 5 — Loops, jumps and twists

In the last of this series, Phil Cohen finishes off with the 'bumps and grinds' of programming — loops, subroutines and the like.

Phil Cohen

WITH A bit of luck, you should by now be familiar with 'linear' programming — how to make the computer do things one after the other in a prescribed sequence.

We now come to an extension of this sort of programming. It deals with how to make the computer repeat things over and over again within a program without the need to type in instructions again and again.

This facility is called a loop. It is usually used in problems where a (relatively) large amount of data has to be handled, and where each piece of data has to be treated in the same way.

Say, for example, that you want a program which prints out the numbers from 1 to 10, followed in each case by the square of the number. One possible way to do this is:

```
10 PRINT "THE SQUARE OF";1;
   "IS";1*1
20 PRINT "THE SQUARE OF";2;
   "IS"; 2*2
```

and so on. It doesn't take much of this sort of programming to convince you that there must be a better way.

The solution in BASIC is the FOR statement. This takes the form: 'FOR I=1 TO 10'. That is, allocate space for a variable called I, set it to 1, then repeat the next set of instructions for I=1, I=2 . . . I=10.

The FOR statement is followed by a number of lines of BASIC program (the part of the program that is to be repeated), followed by a NEXT statement. This NEXT statement takes the form 'NEXT I', where I is the name of the variable which was called up in the FOR statement.

NEXT and FOR statements always appear in pairs, and the computer will produce an error message if this is not the case.

Let's make things a bit clearer with an example which prints out the squares of the numbers from 1 to 10:

```
10 FOR I = 1 TO 10
20 PRINT "THE SQUARE OF";I;
   "IS";I*I
30 NEXT I
40 PRINT "FINISHED"
```

It's as simple as that. The computer will set aside space for I when it comes to line 10, and will set I to 1. It will then do line 20 with I equal to 1. When it gets to line 30, it will remember where it saw a FOR statement using I, and will *jump* back to it, setting I to 2. This process will be repeated until I reaches 10. When this happens, the computer will not jump back at line 30, but will go on to line 40.

I said in the last paragraph that the computer 'jumped' back in the program. This is a concept which is used a lot in BASIC programming — the computer comes to a particular instruction, then as a result of that instruction does *not* go on to the next line, but goes to a different line to continue execution.

Leaving the 'loop' for the moment (we'll come back to it), let's look at a 'purer' version of the jump — the GOTO statement.

This is something which should be used as little as possible in programming, as it tends to make programs less 'readable' to the user when he comes to look at them at a later date. It is also the cause of many of the errors produced by first-time programmers. ▶

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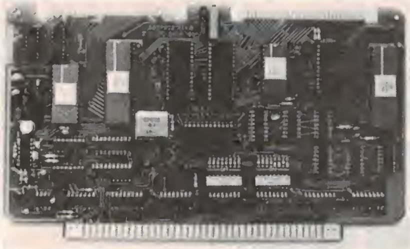

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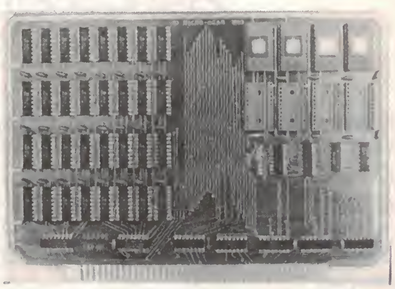

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A GOTO statement, as its name implies, simply tells the computer to *go to* a different part of the program.

For example, 'GOTO 40' will cause the computer to do line number 40 next:

```
10 PRINT "A"
20 GOTO 40
30 PRINT "B"
40 PRINT "C"
50 PRINT "D"
```

will print 'A', then 'C', then 'D', then stop. The order in which the program is written is not the order in which it is executed. Notice that, in the above program, line 30 will *never* be executed — see what I mean about causing errors?

Having covered the GOTO statement in as little detail as possible, I'll now return to the FOR . . . NEXT loop.

To recap, a FOR statement causes the program 'segment' between it and the corresponding NEXT statement to be repeated as defined by what comes after the word FOR.

Some examples:

'FOR J=2 TO 4' will cause the loop to be repeated with J = 2, 3 and 4

'FOR T5%= −1 TO 200' will cause the loop to be repeated with T5% = −1, 0, 1, 2 . . . 199, 200

'FOR R = −3 TO −1' will give R = −3, −2 and −1

A modification of the FOR statement is the use of the word STEP. Notice that in all of the above examples, the step between each successive value of the 'loop' variable is 1. This is not necessarily the case. For example:

'FOR G=0 TO 1 STEP 0.1' will give G = 0, 0.1, 0.2, . . . 0.9 and 1.0

'FOR E=0 TO −4 STEP −1' will give E = 0, −1, −2, −3 and −4

The NEXT statement is not really subject to much clever modification — the most you can do with it is to leave out the name of the variable. The computer will then assume that the *last* FOR statement it saw is the one you're referring to.

Nesting FOR loops

No, this is nothing to do with the creation of lots of little FOR loops.

'Nesting' in computing terms is to do with putting things inside each other — like those Russian 'nesting' dolls, where you take the top off one of them and inside is another one, only smaller.

Nested FOR loops are used where you want to repeat another FOR loop a number of times.

Let's take the example of printing out a multiplication table. You would want one of the numbers which is to be multiplied to start off at 1, then go to 2, and so on up to, say, 12. The other number which is to be multiplied would stay at 1 for the first 12 results, then go to 2 for the next 12, etc.

```
5 PRINT "MULTIPLICATION TABLE"
10 FOR I = 1 TO 12
20 FOR J = 1 TO 12
30 PRINT I;" TIMES ";J;" IS ";I*J
40 NEXT J
50 NEXT I
60 PRINT "FINISHED"
```

Ignoring lines 20 to 40 for the moment, the computer would repeat anything between line 10 and line 50 for I = 1, then for I = 2, then . . . I = 12. Now for *each* value of I, the *inner* loop formed by lines 20 to 40 will cause line 30 to be repeated for J = 1, then J = 2, then . . . J = 12.

The overall effect will be that line 30 will be repeated for I=1, J=1, then I=1, J=2, then I=1, J=3, and so on to I=1, J=12, then I=2, J=1 and so on to I=12, J=12. Both loops would then be completed, and the computer would go on to line 60 and the end of the program.

A common mistake is to put the NEXT statements in the same order as the FOR statements — NEXT I followed by NEXT J. Try covering lines 20 to 40 with your fingers and then imagining what effect this mistake would have.

Leaving the variable name out of the NEXT statement in cases like this could be dangerous — nested loops can be a trifle confusing, and the variable name is often only an aid to the programmer, rather than being a necessary part of the program.

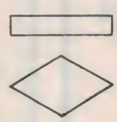
Flowcharts

Flowcharting is a very common means of planning how a program is to be written. A flowchart is to a program what a map is to a street directory — it shows how the statements of a program are connected in a graphical form.

There are a number of flowcharting symbols which are fairly standard and commonly used. Most textbooks give long lists of flowcharting symbols for things like line printer output and disk storage, but (especially at this stage) we really only need two:

1

2



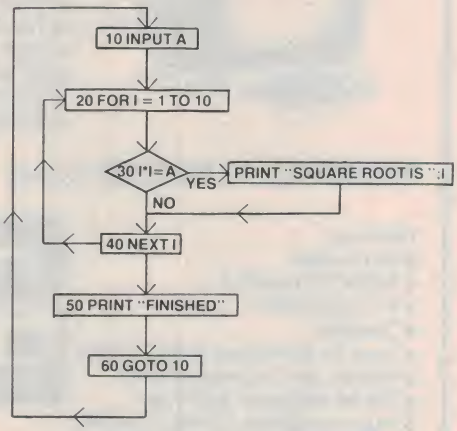
Number 1 represents a simple statement — like 'A = 2*B' or 'PRINT Z'. Number 2 represents an IF statement (remember IF statements? IF not, look up part 4 of the series).

Let's look at the flowchart for the following program:

```
10 INPUT A
20 FOR I=1 TO 10
30 IF I*I=A THEN PRINT "SQUARE ROOT IS ";I
40 NEXT I
50 PRINT "FINISHED"
60 GOTO 10
```

which is a program that takes in a number, finds the square root of each of the numbers from 1 to 10 and compares each with the number which was read in — if it is the same it prints a message — then goes back and does it all again.

The flowchart looks like this:



The program starts at line 10, then goes on to line 20, which is the start of the FOR loop. Coming out of the bottom of the line 20 box, we encounter the diamond-shaped box which is the 'decision' part of line 30. Any diamond like this in a flowchart represents a decision — if the result of the relational equation is true, then take the path marked 'YES', if the result is false, take the 'NO' path.

The arrows show the direction of the program flow (thus *flow*chart). Arrows are usually only required on the entry to boxes and on line segments where the flow is either up the page or to the left.

Following the flowchart along the 'YES' path out of the diamond, we find the rest of line 30. Going through this, we find ourselves at the next line of program — line 40.

Notice that the meeting of the two paths just above line 40 indicates that, no matter what the result of the relational expression in line 30, the next line to be executed is still line 40.

Line 40 is the end of the FOR loop started in line 20, and a path out of the side of line 40 indicates that this is the flow until the loop is completed. So the computer would follow the path back to line 20, and so on round the loop through line 30 ten times. When the loop was completed, the computer would go on to line 50.

Line 60 is a statement which sends the computer back to line 10 — this is shown by the flow out of the bottom of

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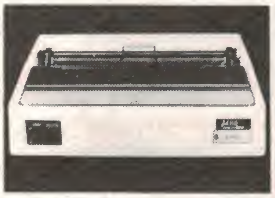

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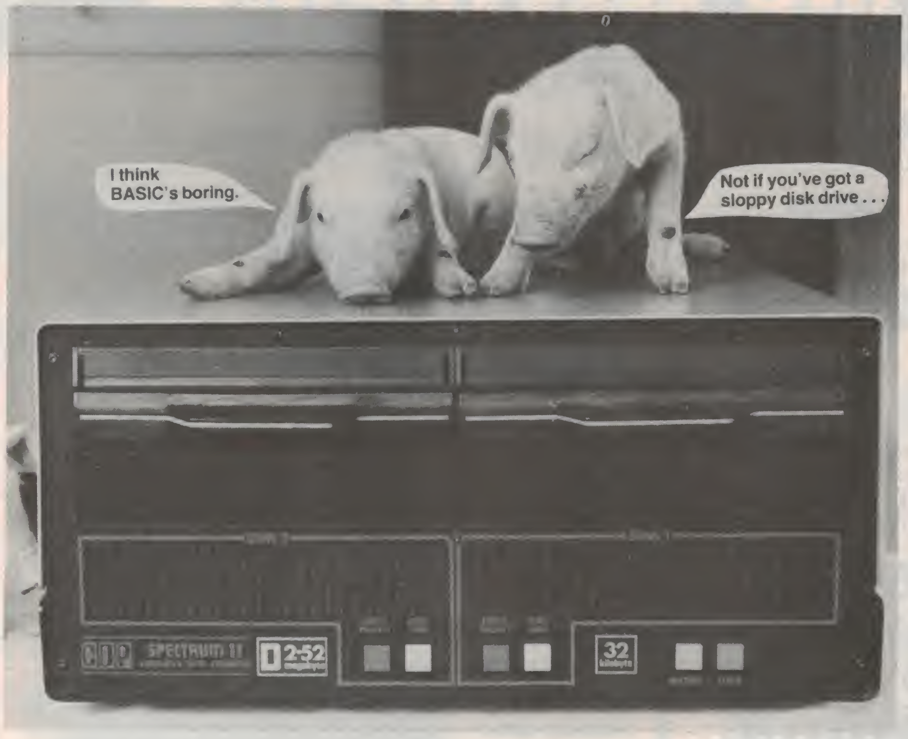
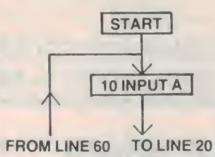


line 60 leading straight back to the start of the program.

Notice that the line going into the top of line 10 makes it a little difficult to decide where the start of the program is. For this reason, it is usually to mark the start of a program using a symbol like this:

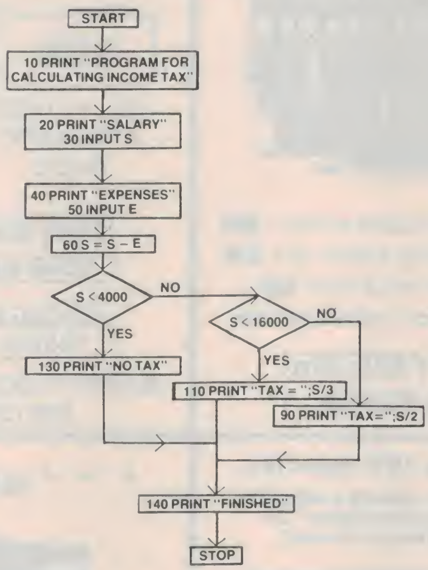
START

The first part of the flowchart would then look like this:



Although in this example (which I chose because it illustrated most of the things normally found on a flowchart) the flowchart tends, if anything, to make the program *less* easy to follow, flowcharts can clarify programs considerably. For example:

```
10 PRINT "PROGRAM FOR CAL-
   CULATING INCOME TAX"
20 PRINT "SALARY"
30 INPUT S
40 PRINT "EXPENSES"
50 INPUT E
60 S=S−E
70 IF S <4000 THEN GOTO 130
80 IF S <16000 THEN GOTO 110
90 PRINT "TAX="; S/2
100 GOTO 140
110 PRINT "TAX="; S/3
120 GOTO 140
130 PRINT "NO TAX"
140 PRINT "FINISHED"
```



A few things to notice about this example — lines 20 and 30 (and also 40 and 50) are enclosed in one box for the pair. This is because they represent a single 'action'. This sort of thing is largely a matter of personal taste — as the flowchart is usually for the use of the programmer only — but I think that putting those lines into two, rather than four, boxes picks out their function better.

Notice that in an IF statement type of box, the YES and NO outlets don't have to be in any particular direction — as long as they're labelled properly, they can go in any direction that helps the layout of the flowchart.

Also notice the addition of the STOP box at the bottom of the flowchart. In some cases, the end of a program is a bit difficult to spot, too.

This example should convince you that the use of flowcharts in cases where the 'flow' of the program is a bit complicated will pay for itself in terms of your time.

Subroutines — programming's soft shoe shuffle

In cases where a particular process or sequence of steps is used a lot in different parts of the program, a subroutine allows the programmer to get away with writing that sequence once only, and calling it up from different parts of the program.

Let's take the example of a program which prints out the squares of the even numbers between 1 and 10, then the squares of the odd numbers between 1 and 10 (I know it's a bit contrived — but it's only an example).

One way to do it would be:

```
10 FOR I=2 TO 10 STEP 2
20 PRINT "THE SQUARE OF ";I;
   " IS ";I*I
30 NEXT I
40 FOR I=1 TO 9 STEP 2
50 PRINT "THE SQUARE OF ";I;
   " IS ";I*I
60 NEXT I
```

(notice the use of the word STEP in lines 10 and 40). Line 20 is the same as line 50. In this example, typing the same line in twice is no great problem — but what if it were fifty lines, instead of just one? Another way to do the same thing is:

```
10 FOR I=2 TO 10 STEP 2
20 GOSUB 80
30 NEXT I
40 FOR I=1 TO 9 STEP 2
50 GOSUB 80
60 NEXT I
70 END
80 PRINT "THE SQUARE OF ";I;
   " IS ";I*I
90 RETURN
```

Ignoring lines 20 and 50 for the moment, you can see that the program is essentially the same as before — except that the BASIC word END has been added at line 70, and that lines 80 and 90 have been added. Lines 80 and 90 make up what is called a 'subroutine'.

When the computer reaches line 20, it takes it as an instruction to go to line 80 — in the same way as if it had read 'GOTO 80', but with one difference. The computer goes to line 80, executes it, then comes to line 90. The BASIC word RETURN means, in effect, 'go back to the last GOSUB you encountered'. The computer would therefore get to line 90 and interpret it as an instruction to jump back to the end of line 20. Notice ▶

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BACKUP	IF..THEN	SYS	LEFT$
CLOSE	INPUT	VERIFY	RIGHT$
CLR	INPUT #	WAIT	MID$
CMD	LET		CHR$
COLLECT	LIST	SGN	ASC
CONCAT	LOAD	INT	LEN
CONT	NEW	ABS	VAL
COPY	ON..GOSUB	SQR	STR$
DATA	OPEN	SIN	TI
DCLOSE	POKE	COS	TI$
DEF/FN	PRWT	TAN	ST
DIM	READ	ATN	DS
DIRECTORY	RECORD	LOG	DS$
DLOAD	REM	EXP	+
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Example — graph drawer

This program is more spectacular than useful, but it shows how many of the features of BASIC are used. The program draws the graph of the function which is in the subroutine by putting asterisks on the screen at the appropriate points. To simplify the programming, the x-axis runs down the screen, and the y-axis across it.

Line 10 dimensions the array V with 20 locations. Lines 20 and 30 input the upper and lower limits of the values of X, which the program is to feed into the equation in the subroutine.

Line 40 calculates the size of the step in X between each line of output. There are going to be 20 lines, each representing the value of Y at each of 20 values of X, the values of X chosen at equal distances between the 'FROM' value and the 'TO' value.

Line 50 sets X to its first value — the 'FROM' value.

The loop formed by lines 60 to 100 calls the subroutine for the current value of X, then puts the result into V(), then increases X so that it is at its next value.

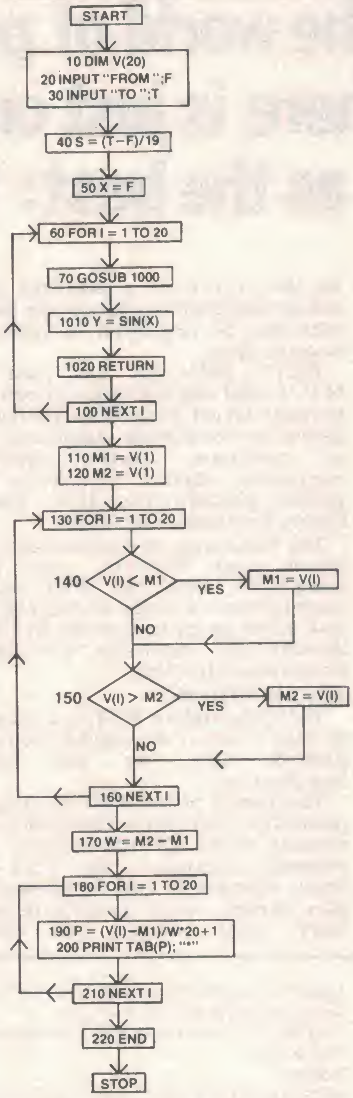
By the time the computer reaches line 110, V() will hold the values of Y from X=F to X=T. Now we come to a problem — we have no way of knowing what 'scale' to use for the y-axis, and we don't want the asterisks to 'appear' off the screen. The solution is to find the maximum and minimum values in V() and adjust the scale accordingly.

Lines 110 and 120 set M1 and M2 (which are to hold the minimum and maximum values in V() respectively) to the value of V(1). This ensures that, even if the values in V() are very large positive or negative numbers, M1 and M2 will always be somewhere between the minimum and maximum values in V().

The loop formed by 130 to 160 compares M1 and M2 to each of the values in V(). In the case of M1, if the value in V(I) is *less* than the value in M1, then the value of M1 *becomes* the value of V(I). In this way, by the time it has gone through the whole of V(), M1 will be equal to the minimum value in V(). In the same way, M2 will be equal to the maximum value.

Line 170 works out W, the width of the scale — this is the range of values in V(), the maximum value minus the minimum value.

The loop formed by lines 180 to 210 prints the graph. Line 190 works out the position across the screen that the value of V(I) represents. This is the value of V(I) minus the minimum value (which, if you think about it, gives a value somewhere between 0 and W) divided by W (which gives a value between 0 and 1), times 20 plus 1 (which gives a value between 1 and 21).



Line 200 puts an asterisk on the screen at a point P spaces from the left. Notice that line 200 causes a new line every time through the loop. In this way, the output of the program will be a sequence of lines, each with an asterisk at a particular distance from the left, the left-most asterisk (representing the minimum value of V()) being at the extreme left of the screen, and the right-most asterisk (representing the maximum value of V()) being 21 spaces from the left.

Sample Program — 'Graph Drawer'–

```
10 DIM V(20)
20 INPUT "FROM ";F
30 INPUT "TO ";T
40 S = (T - F) / 19
50 X = F
60 FOR I = 1 TO 20
70 GOSUB 1000
80 V(I) = Y
90 X = X + S
100 NEXT I
110 M1 = V(1)
120 M2 = V(1)
130 FOR I = 1 TO 20
140 IF V(I) < M1 THEN M1 = V(I)
150 IF V(I) > M2 THEN M2 = V(I)
160 NEXT I
170 W = M2 - M1
180 FOR I = 1 TO 20
190 P = (V(I) - M1) / W * 20 + 1
200 PRINT TAB(P); "*"
210 NEXT I
220 END
1000 REM USER SUBROUTINE STARTS
     HERE
1010 Y = SIN(X)
1020 RETURN

FROM ? -3
TO ? 3
```

Sample program output.

Line 220 stops the computer from entering the subroutine at the wrong time. Notice that the first line of the subroutine is line 1000 (giving plenty of room for expansion of the main program) and that it carries a REM which describes the subroutine.

The subroutine itself can be any function — even one which covers several lines. The only restriction is that the variable names used in the main program must not be used in the subroutine, except X and Y.

Also shown is a typical output from the program — as you can see, it's more decorative than useful. But it does give an idea of the shape of the function.

that it's the *end* of the line, not the beginning — the next line it will execute will be line 30.

The same thing will happen on the other times round the loop — the computer will jump to the subroutine (which starts at line 80), execute the subroutine then jump back to the end of the line with the GOSUB in it — in this case line 50.

After all the results have been printed out, the computer will come to line 70, and the program will stop. The word END has the same effect as the end of the program — it is put in here to prevent the computer from trying to execute the subroutine 'out of context'. We only want the subroutine to be entered from lines 20 and 50.

If we had not put line 70 in, by the way, the computer would have executed line 80 all right — but we would have got an error message at line 90. The computer remembers how many times it has met GOSUB and how many times it has met RETURN, and if it finds too many RETURNs it knows something is wrong.

You can 'call' a subroutine from *inside* another subroutine — the computer will go back to the *last* GOSUB it encountered, and it will still remember where the one before that

was, too. In fact, most small computers will allow subroutines to be nested up to a limit of about six — that is, you can call a subroutine from within a subroutine which has been called from a subroutine which has been called from a subroutine which . . . up to a limit of six 'deep'.

This facility is not very often used, however, and so I won't give an example.

It is usual to start the numbering of the lines of a subroutine at 1000 or 500, or thereabouts — for two reasons. The first is that the line number which appears in the GOSUB will be easier to remember, and the second is that if you want to add to the 'main' program (the part of the program which is not subroutine), there needs to be plenty of available numbers for expansion. Remember, BASIC only looks at the *order* in which the line numbers run — the actual *values* are not important.

It is also quite usual to have several subroutines to do different things, and to call them by putting different line numbers in the GOSUB. I mentioned this because it is also a good idea to write the line number of each subroutine on a piece of paper as you write the program, along with a couple of words to remind you what each of them does.

Some languages allow you to give each subroutine a name, and to call it by using that name (rather like a variable name, only longer). For example, in the last program we could have used the name 'OUTPUT' for the subroutine. BASIC does not allow this. In fact, this is one of the most commonly cited disadvantages of BASIC.

Bits and pieces

Throughout the whole of this series, I've made a practice of *not* introducing those features of BASIC which are not essential — if you like, I've tried to cover the use of the steering and gears without telling you where the cigarette lighter and window demister are. Here, then, are a few of the things I've missed out on the way:

Multiple lines: In BASIC, the colon ':' is used to speed up a program by allowing several lines to use the same line number. For example:

```
10 A=1
20 B=1
30 C=1
40 PRINT "HELLO"
```

could be written:

```
10 A=1 : B=1 : C=1 : PRINT "HELLO"
```

Naturally, if you want to insert 'D=1' after 'C=1', then you have to change the whole line. Use of the colon speeds the program up, however, due to the fact that the computer doesn't have to keep looking for the number of the next line.

Remarks: At various points during the program, you may wish to put little notes to yourself, telling you what that part of the program does. The BASIC word REM (short for remark) is used for this purpose. Anything to the right of the word REM is ignored by the computer during execution — it will still LIST it, however, so that you can read it. A very useful place to use REM is at the start of a subroutine — so that you can spot the start. (See the example on the opposite page). Notice, however, that *anything* to the right of REM is ignored — this includes colons!

Removing spaces: Another way to increase the speed at which a program runs is to remove all the spaces in the lines of program. For example,

```
10 A=1 : B=1 : C=1 : PRINT "HELLO"
```

would become:

```
10A=1:B=1:C=1PRINT"HELLO"
```

This speeds up execution because the computer does not have to worry about the spaces. BASIC is constructed in such a way that at no time does the absence of a space affect execution (except within the quotes in a PRINT statement, of course). The disadvantage of removing all the spaces is that the program becomes almost unreadable to the programmer. I consider this a disadvantage — I suggest the removal of spaces only in those parts of the program which limit the speed, and only *after* the program is working properly. Some people think themselves better programmers because they leave out all the spaces, so that their programs run faster than anyone else's. I consider this a rather short-sighted attitude.

One-line INPUT statements: In previous examples, INPUT of data needed two lines — the first to PRINT a message describing the data to be input, and the second to INPUT the data. BASIC allows this to be done on one line:

```
10 INPUT "WHAT IS THE VALUE OF A ";A
```

with the message to be printed in quotes, followed by a semi-colon (usually, *only* a semi-colon is allowed), followed by the name of the variable. This method has the advantage that the question mark which is produced by the INPUT statement appears on the screen on the same line as the message:

'WHAT IS THE VALUE OF A ?'

READ statements: Although most of the programs written on domestic computers are interactive (they use INPUT statements to get data into the program), there are cases where an older method (by which programs were put into the computer on punched cards) is useful. This method uses two BASIC words: READ and DATA.

The first takes the place of an INPUT statement, with two differences — no message may be printed out, and more than one variable may be put after the word READ. For example: '10 READ A, B, V(I)' is acceptable (only commas may be used between the variable names). This will allocate values to A, B and V(I) in the same way as an INPUT statement, except that the values will come from within the program.

Somewhere in the program (it doesn't matter where), there will be one or more DATA statements, which will hold values for the variables: '20 DATA 3, 4.5, 7.9' (again, separated by commas). The DATA statements in a program may be considered to be totally separate (the computer will ignore them in the same way it ignores REM statements) and continuous in the order in which they appear in the program. That is, '20 DATA 3', '30 DATA 4.5, 7.9' will give the same result as the example above. Successive READ statements will use up the values in the DATA statements in order — having used up all the values, any further READ statements will cause an error message.

This method has the advantage that large amounts of data which do not change each time a program is run may be typed into the program once only. A program which tells you when the next train is due may have the train timetables entered in this way, for example. String variables can also be handled, again separated by commas (so the variable can't have commas in it).

Further reading ...

There are many good books on programming, but by far the best thing to study if you're interested in programming is . . . a computer. Computers with a BASIC capability start at about \$300, and after reading this series you should be in a position to judge whether a computer's capabilities are worth \$300 to you.

Although there are many individuals who own small computers, there seems (to me, at any rate) to be a surprising shortage of them in places like engineering design offices, universities, research establishments, small businesses and the like. Many people seem to think that a 'small' computer (i.e: under \$5000) is not capable of doing anything useful — just a toy. This is definitely not the case, and the capabilities described in this series of articles can be found in most machines around the \$1000 mark. ●

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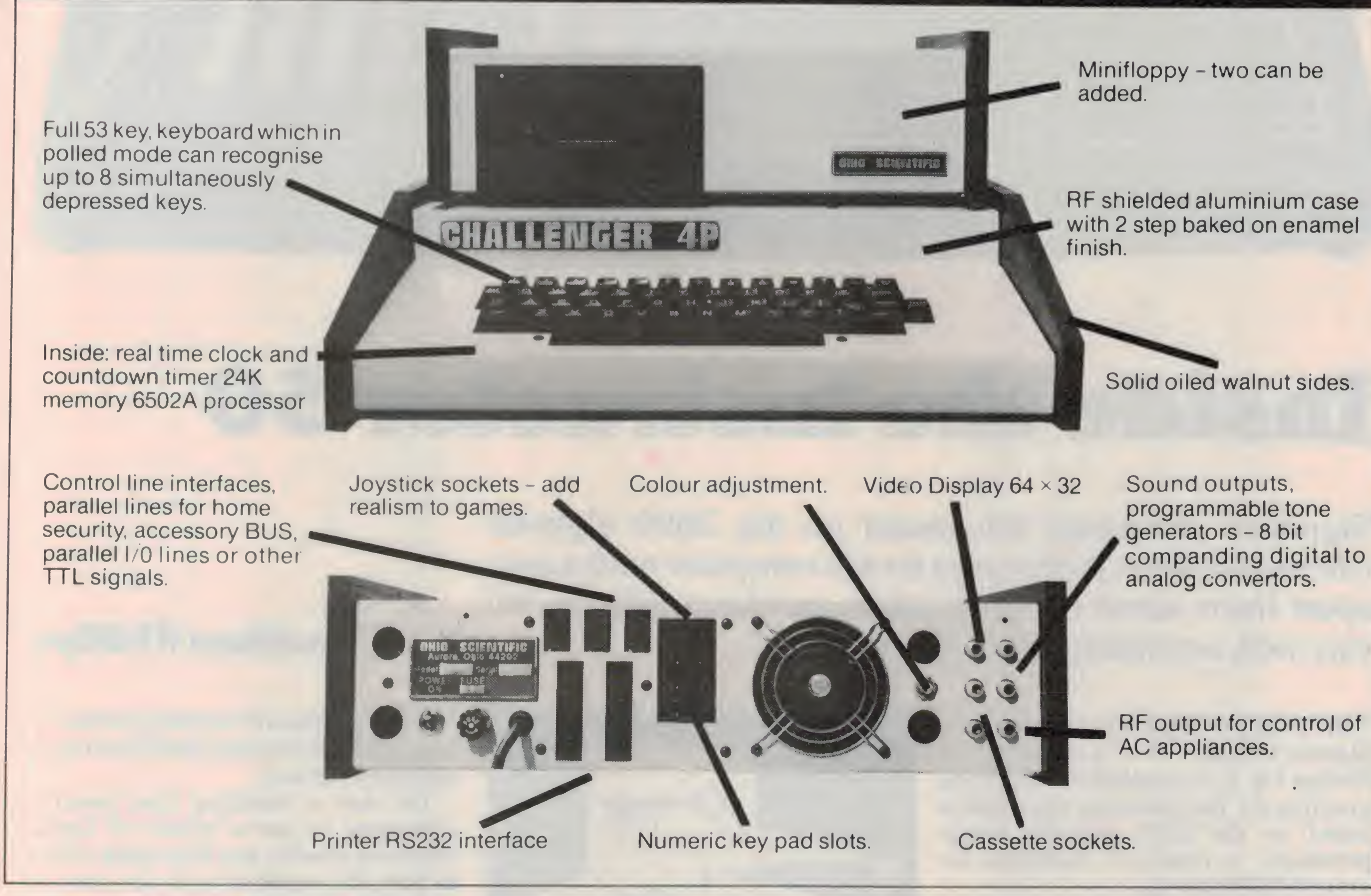

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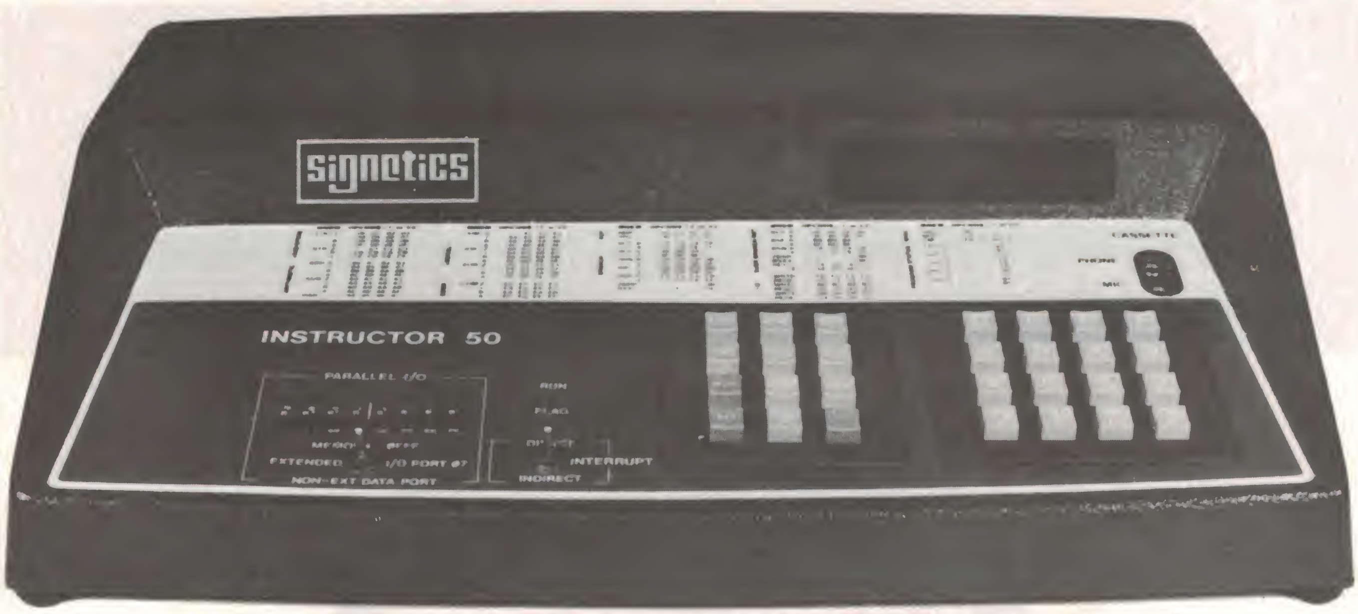


Inside the Instructor 50

Signetics' Instructor 50, based on the 2650 eight-bit microprocessor, is designed for the computer novice and, apart from some documentation problems, fills the bill very well, according to Jonathan Phillips.

Jonathan Phillips

THE INSTRUCTOR 50 is produced by Signetics in the US — a subsidiary of Philips US. It is intended as a teaching machine for the first-time user, and is based on the 2650 eight-bit microprocessor. It retails in Australia for around $350 plus tax.

The Instructor comes in a package which includes three books that give everything from an introduction to microprocessors to the complete circuit diagrams of the machine. Also in the package is a cassette which holds eight sample programs and a spoken commentary. The Instructor is supplied complete with power supply.

All that is required to get the whole package up and running is a domestic cassette recorder — the Instructor package even includes the leads needed to connect it up!

Documentation

Part of the package which comes with the Instructor 50 is a book titled "Introduction to the Instructor 50 Desktop Computer". Naturally, it was the first one I picked up.

It appeared to be a bog-standard microcomputer teaching text, complete with pictures of an abacus and diagrams showing how switches and batteries can be used to simulate AND gates.

Signetics have put a lot of work into this volume, which runs to about 150 pages.

Unfortunately, the user gets to Chapter 4 without having found out anything about the Instructor 50, and having been confused by a lot of talk about flip-flops and counting circuits — none of which has any direct bearing on the following text.

The sort of thinking that found it necessary to put a precis of digital electronics before any discussion of how to turn the machine on is the same as that which taught the structure of the atom in electronics courses before introducing Ohm's Law. How many times have you used the concept of the stationary electron in electronic design?

Okay, we're at the start of Chapter 4 and we've just been told that the data buss in the Instructor 50 is "thus said to be bi-directional in nature". Finally we get to a diagram which shows the registers in the 2650.

From here on in, the text takes a distinct turn for the better. It finishes, having covered the addressing modes of the machine, with a discussion of how to hand-assemble machine code programs.

The next volume I looked at was called "Desktop Computer Software Applications Manual". It claimed to be Chapter 6 of the "Introduction to . . ." book, extended and put into a different volume.

Basically, it's a manual for the tape read and write operation of the machine, and a manual for each of the example programs contained on the tape which comes in the package.

The programs are extremely well documented, with a full assembly listing given for each, as well as a discussion of the subroutine structures.

The only criticism I have of this part of the package is that the programs *seem* to be written with the idea of entertaining the user, rather than teaching specific techniques.

Finally, I looked at "The Instructor 50 Desktop Computer User's Guide". This is a thick volume which begins with what seems to be an introduction to microprocessing for those already rather familiar with mainframe computers (quote: "A microcomputer looks, architecturally, like any other computer").

Having given a fairly precise rundown of the terms and concepts used in microprocessing, the text goes on to explain how to turn the machine on, and how to get a couple of the sample programs up and running.

There then follows an excellent user's manual, giving concise instructions on the use of all of the hardware and software facilities of the machine.

The text gives the start address and a description of all of the useful monitor subroutines, and goes on to describe the hardware of the machine in some detail, including the instruction set of the 2650 and full circuit diagrams for the Instructor. A complete monitor listing is given.

All in all, I would say that the hardware and software documentation is a good deal better than most machines on the market, and more than adequate for any serious user.

I would not recommend the existing set of manuals to a complete beginner who is trying to work his/her way through them alone. I would suggest that anyone intending to buy the machine for this purpose also spend some time and money finding a couple of good teaching texts (see reviews in ETIs to come — Ed).

Having said that, however, and given a decent primer and a bit of application, the Instructor 50 is an excellent beginner's machine.

Demonstration Tape

The demonstration tape which comes with the Instructor 50 package deserves a special mention — even if only a warning.

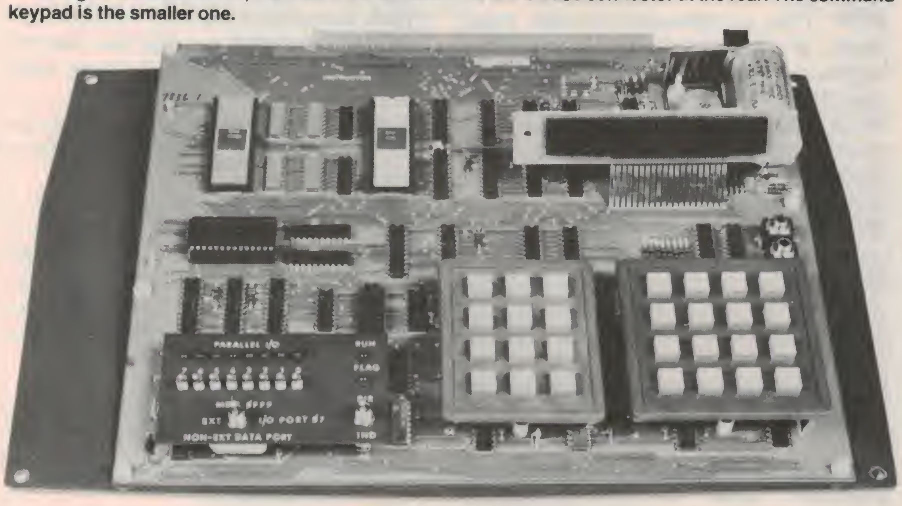
The software aspects of the tape are fine — each of the programs is recorded twice, and there is a long section of recorded data at the start of the tape to allow the user to set up the level control of the recorder (see description of I/O).

The problem lies in what *else* is on the tape. Each of the programs is separated by a long section of what sounds like an American newsreader going full tilt, complete with incredibly accurate pronunciation and stresses in all the right places.

Not that I found this particularly annoying in itself — perhaps I should explain a little further. Having used the long data segment at the start of the tape to set up the level at the earphone output of the recorder, I did not feel inclined to change the level — the tape warns you not to, in fact. This meant that the only way to find the next recorded program was to play the tape (with newsreader at full tilt) at almost full volume — which is where the level setting ended up.

The voice on the tape suggests that if the level between programs is too high, the user should "put something over the speaker of the recorder". I did. I ended up with my hand clasped very tightly over the speaker.

The King's new clothes! Or, the Instructor 50 naked. Note the buss connector at the rear. The command keypad is the smaller one.



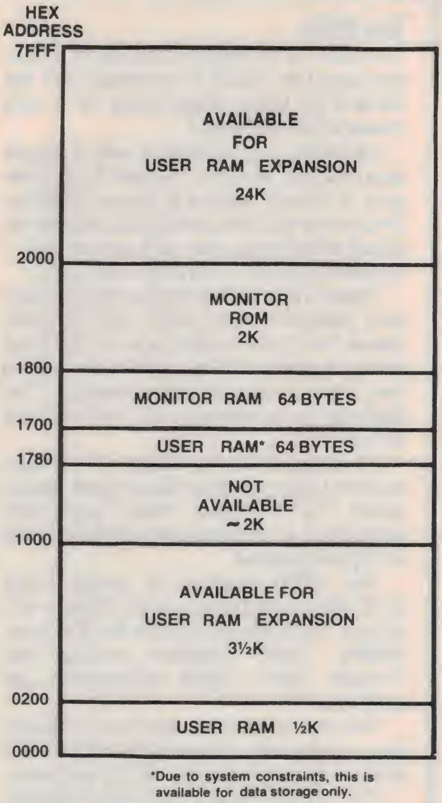


Figure 1. **This shows the memory organisation of the Instructor. The addressing capability of the 2650 is 32K.**

Mechanics

The housing of the Instructor is simple, well thought out and effective. All of the electronics is mounted on a single board (including the two keyboards — one for command keys and the other a hex keypad).

This single board is simply fitted into a two-piece, moulded plastic case, with a window for the display and a hole in the back for the edge connector.

The top of the case has printed on it a table which gives a list of the instruction set of the 2650 and the corresponding hex codes.

Holes in the bottom of the case allow access to the jumpers, which allow the user to select such things as the source of interrupt signals (keyboard, real-time clock (provided), or S-100 buss), S-100 clock source, power source select (socket or S-100 buss) and cassette output level (30 mV or 300 mV).

The power to the Instructor 50 comes in at the back, via a calculator-type power connector. The power supply is provided.

Removing the top cover reveals that the Instructor board can be used quite happily without the case — all of the front panel switches are mounted on a sub-assembly which carries labels identifying the switch positions. This could be very useful for those who wish to explore the internal operation of the ▶

The 2650

The 2650 is an eight-bit processor which, although very much in the shadow of the 8080/Z-80 family these days, is a very powerful device indeed.

Internally, it's organised with a single accumulator (known as register 0), and two sets of three general-purpose registers. The machine can be switched to operate on either set of three under software control — a similar system to that used in the Z-80.

There is also a 16-bit status register (split into 'program status high' and 'program status low' 8-bit words), and a 2-bit page control 'register' which is effectively the top two bits of the program counter. The addressing capability is 32K, split into four 8K pages.

An unusual feature is an on-chip subroutine return address stage (eight deep), which, by the way, holds eight 32K addresses — so that page boundaries don't worry subroutines.

The 2650 requires a single clock (1.25 MHz maximum) and a single +5 V supply. All inputs and outputs are TTL compatible. Static operation means that variable clock speed applications are possible.

One input and one output pin on the chip are 'connected' to two of the bits of the status register, making serial I/O very easy.

The interrupt sequence is rather interesting — one of the peripherals makes the INTREQ (Interrupt Request) line of the processor active. The processor finishes the current instruction, then takes in the byte currently on the data buss — this byte is put on by the interrupting peripheral. This byte gives the subroutine address (directly or indirectly).

Addressing modes possible with the 2650 are:

— immediate addressing, where the first byte holds a 'register address' and the second holds data.

— relative addressing, where a register address' is given, along with a −64 to +63 displacement. This can either be direct, with the resultant address being the contents of the register plus the displacement, or indirect, with the resultant address being found in memory at the 'direct' address.

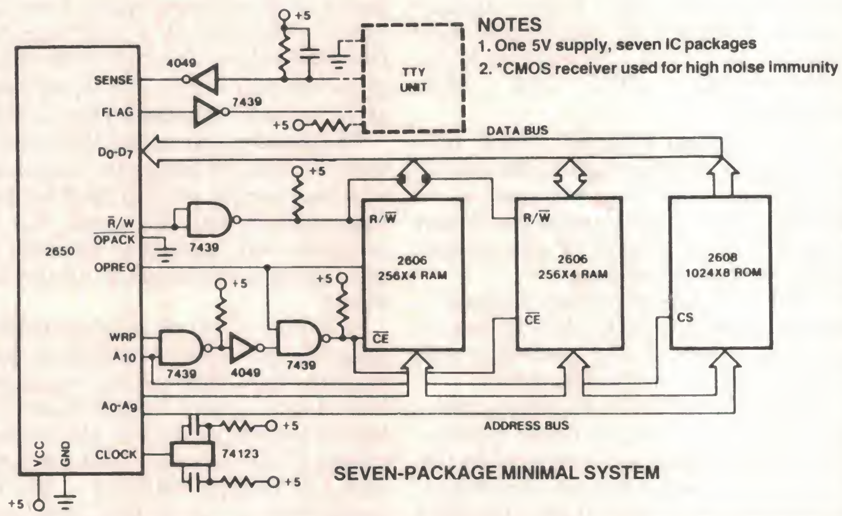
— absolute addressing, in which the address is specified completely in the instruction. This allows page crossing (with branch instructions only, though).

— indirect addressing, in which the address in the instruction is the address of the memory location where the *address* of the data is found.

The above is a very much boiled-down version of the addressing modes. In order to specify them fully, I would need the four pages used by the authors of the Instructor 50 manuals. Suffice it to say that the 2650 has some powerful addressing modes.

The instruction set of the 2650 is perhaps a little less flexible than that of the Z-80, and a little more flexible than that of the 8080. It has some interesting features, such as 'branch on incrementing register' instructions, which make loops very easy.

All in all, the 2650 is probably about as much as a beginner could handle. And since the Instructor 50 is about beginners, it's an ideal choice.



SEVEN-PACKAGE MINIMAL SYSTEM

machine (with the aid of the circuit diagrams provided in the manual).

The board itself is a high-quality double-sided board with solder mask and silk-screened component identifications. The S-100 edge connector looks as if it's gold plated.

The Instructor 50 has an on-board regulator which provides the single +5 V supply required by the 2650 and by all of the 74LS series components on the board.

Four ICs are mounted on IC sockets — the processor itself, the ROM, and some programmable logic arrays. The display is eight-digit seven-segment, and is mounted at an angle directly onto the main board, using what look like very long edge connector sockets.

All in all, the board is very pretty indeed, and would not look out of place in any S-100 system.

Controls, Indicators and I/O

The front panel of the Instructor holds two keyboards (both mounted directly onto the circuit board). One is a hex keypad, giving 0 to 9 and A to F. The other has the main controls for machine operation:

SENS: This is simply connected to the 'sense' input of the 2650 processor — pressing this key will put a '1' in one of the positions of the processor's status register bits.

INT: This key is connected to the 'interrupt' input of the processor — pressing it will send the processor to an interrupt routine.

MON: Pressing this key at any time returns control to the monitor.

RST: This is connected to the 'reset' input of the processor — execution begins again at address 0. This is usually the start of the user program.

WCAS: Pressing this key will cause the machine to ask for some further information, then begin transferring a portion of memory to tape.

RCAS: Similar to WCAS, but for reading a program from tape.

STEP: This causes the machine to execute the next single instruction, displaying the next byte to be addressed.

RUN: Begins program execution at the point specified by the user.

BKPT: Allows the user to specify/examine a breakpoint. Whenever the processor gets to the breakpoint address, it will stop and go into 'single step' mode.

REG, MEM, ENT/NEXT: These keys, along with the hex keypad, allow the user to examine and modify the contents of the processor's registers (stored in memory while under the control of the monitor), including the program counter. They also allow memory to be examined or modified, either one at a time or using a 'fast patch' mode, in which successive memory location contents are entered on the hex keypad without the need to press any other keys.

An eight-digit hex display allows the user to be prompted to enter data, shows results, etc.

The front panel also holds a set of eight switches and eight LEDs which allow easy input and output of single bits of information from user programs. A three-position switch on the front panel lets the user select whether these eight switches and indicators are:

— at address $OFFF_{16}$,

— at port address 7 (the 2650's I/O structure allows up to 256 'ports', which are accessed by special I/O instructions), or

— at 'non-extended' port D — yet another I/O mode of the 2650 allowing one-byte instructions to read or write to two ports.

If the first of these three possibilities is selected, this means that whenever a user program reads from address OFFF, it will read whatever is set up on the eight switches. Similarly, the LEDs will show whatever is written to OFFF.

A 'FLAG' LED on the machine shows the state of the processor's 'flag' output — which is set by one of the bits in the status register.

A 'RUN' LED shows whether the 2650 is executing instructions, or is sitting at a HALT instruction. The LED also indicates that the processor is halted when the S-100 buss PAUSE line is active.

The interrupt facilities of the Instructor are very comprehensive. A switch on the front panel allows the selection of a 'direct' interrupt — in which the processor goes to location 07, then begins execution — or 'indirect' — in which the processor goes to the subroutine whose start address is found at 07. A switch on the underside of the Instructor even allows the interrupt switch on the keyboard to be replaced by an automatically-generated interrupt at ac mains frequency — with no further hardware or software needed.

The Instructor's cassette input and output leaves nothing to be desired. Operation is almost fully automatic — the machine even has a 'level adjust' mode, in which the front panel display shows whether the level of the incoming cassette audio signal is too high, too low or correct!

The biggest plus, however, must be the S-100 buss capability. Signetics are careful not to call the machine's buss 'S-100' — it's actually S-100 *plus* a few 2650 control signals and with some of the (previously 8080-based) buss signals changed slightly. Signetics have gone to considerable trouble, however, to ensure that most S-100 devices can be connected to the Instructor with the minimum of fuss.

Signetics have left nothing out — the machine is practically transparent to the processor, so that almost any 2650 program will run on the machine with minimal patching.

Similarly, there are very few of the 2650's facilities which cannot be exercised using the Instructor.

All in All

I would say that the Instructor 50 would be an excellent buy for a University or Tech College where tuition on microprocessor fundamentals was available.

For the first-time user who does not have access to a specialist — if you buy an Instructor 50 (and you could do a lot worse), get a textbook to go with it. It will only cost you a few per cent of the total price, and will improve the worth of the investment considerably.

For the S-100 fanatic who is looking for a processor board with excellent onboard facilities, perhaps you should at least consider this board as an alternative to the more popular 8080/Z-80 alternatives — you have nothing to lose but your software. ●

Instructor 50

Manufactured by Signetics — Australian representatives: Philips. Retailed in Sydney by David East Components, 33A Regent St, Kogarah, (02)588-5172, through Sycom, 301 Catherine St, Lilyfield.

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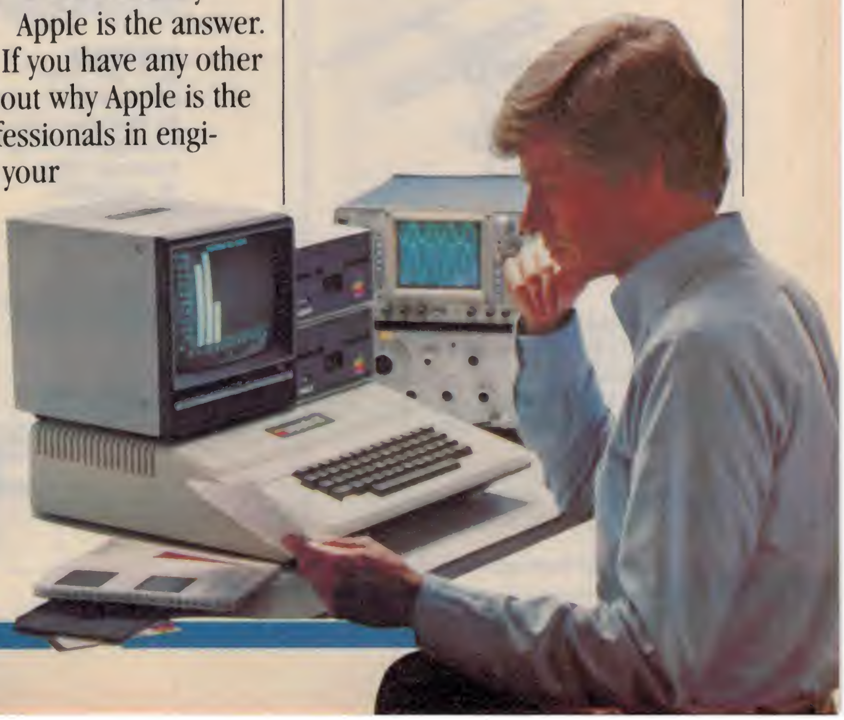

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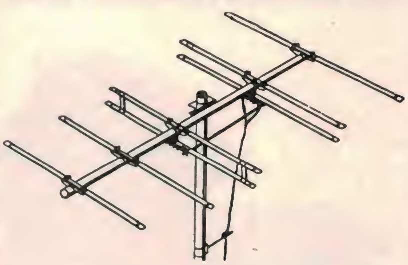

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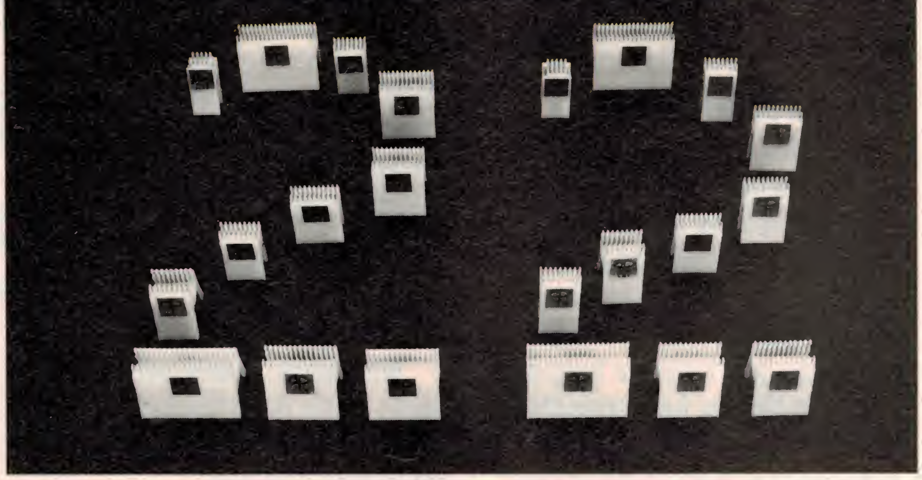

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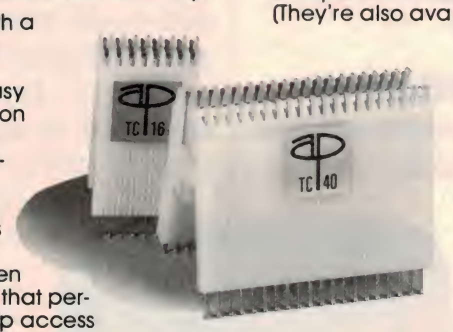

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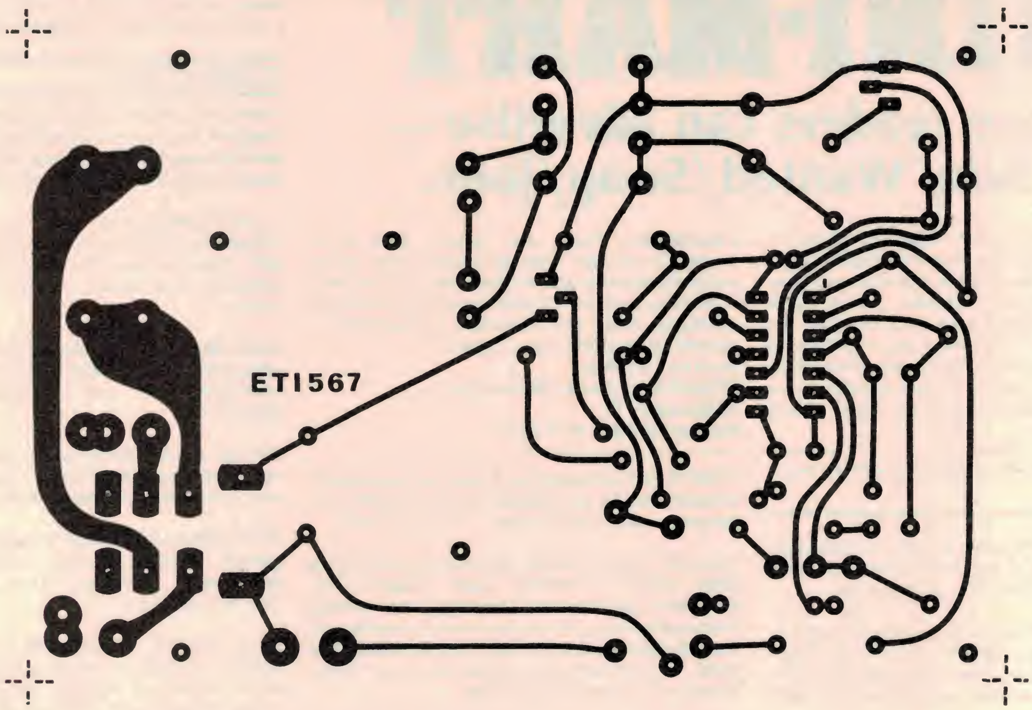
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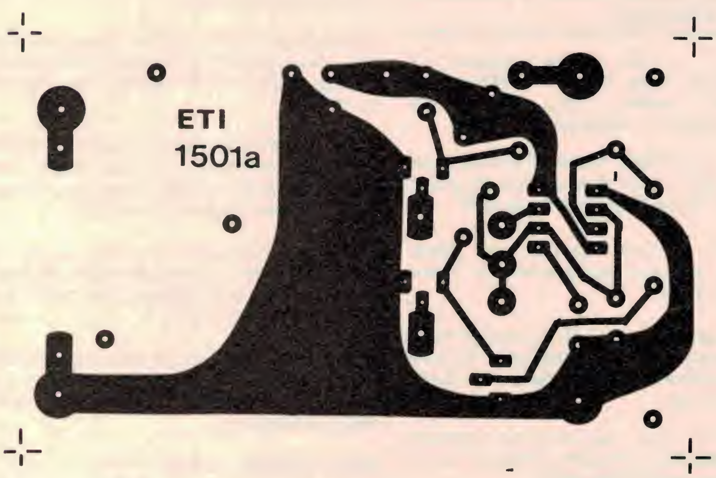
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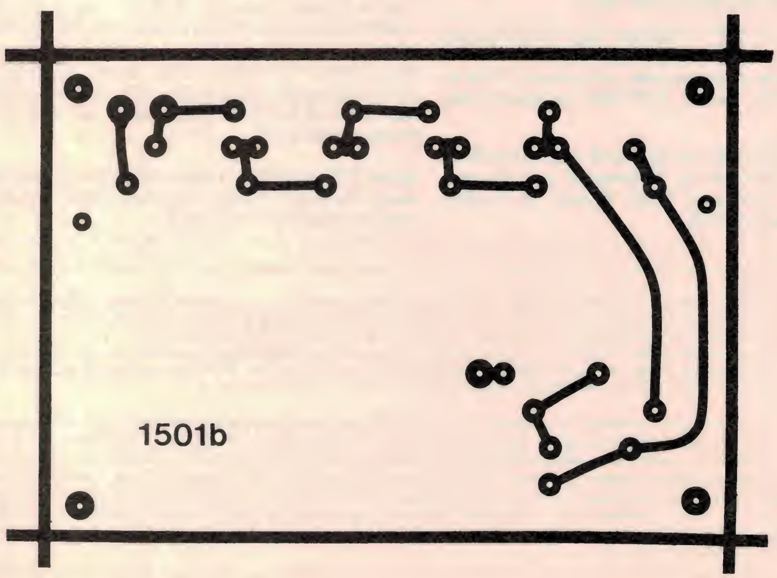
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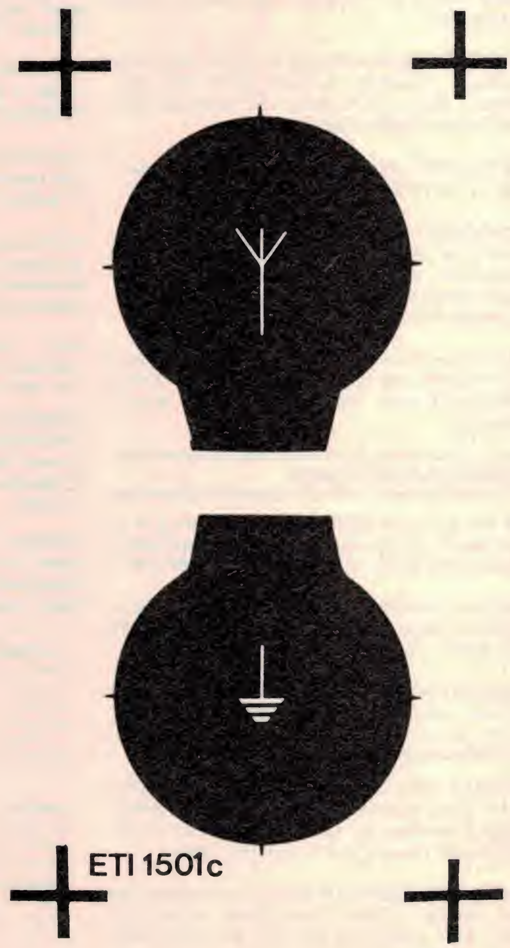
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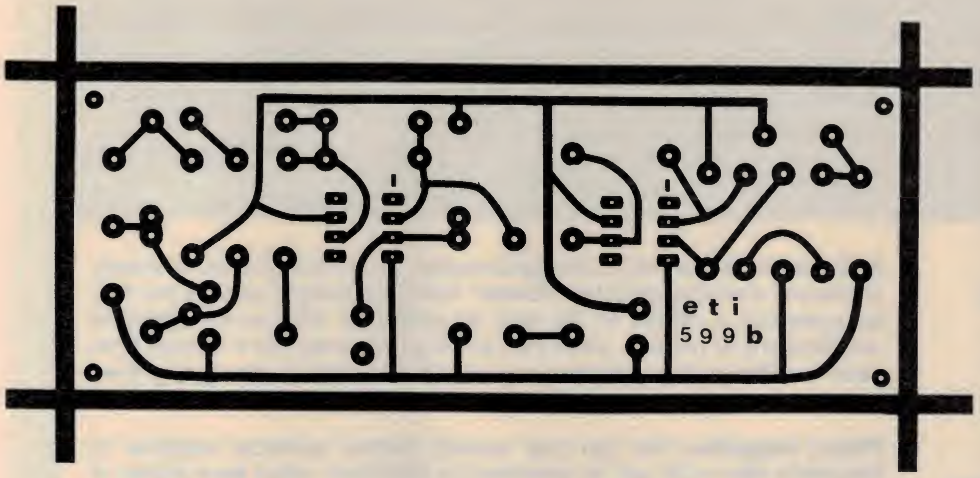


Using ETI PCB Artwork

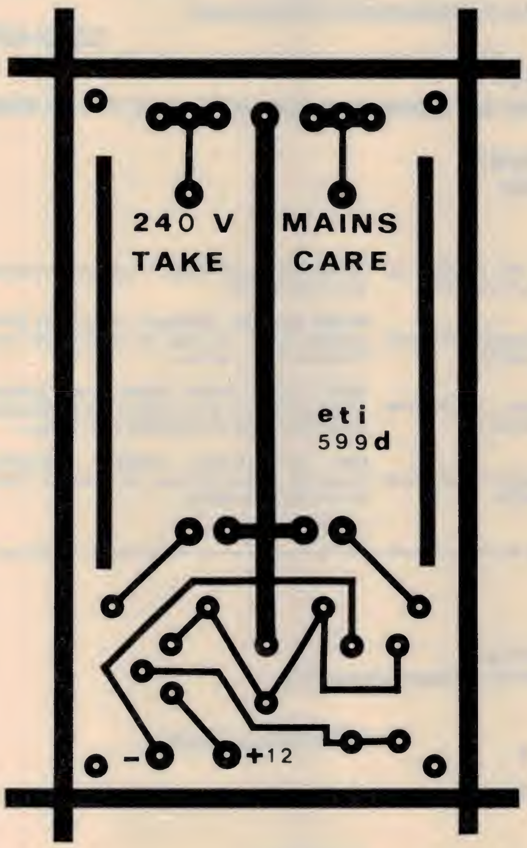
This method can be used to make negatives of ETI artwork from October 1977 on, provided the reverse of the page is printed in blue. The film used is Scotchcal 8007 which is UV sensitive and can be used under normal subdued light.

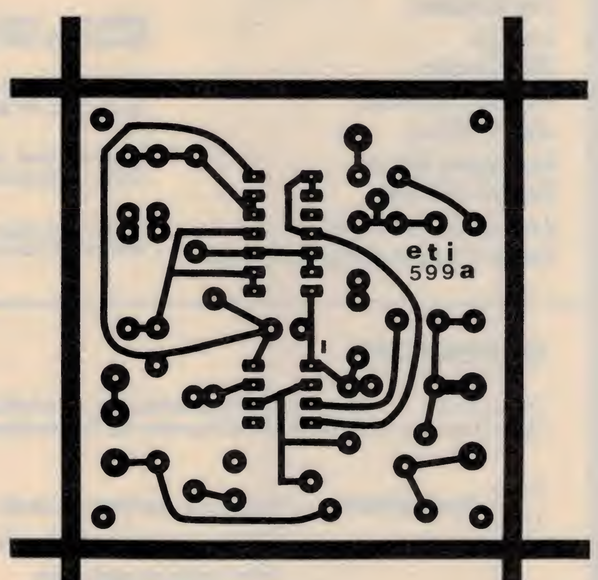
Cut a piece of film a little larger than the pc board and expose it to UV light through the magazine page. The non-emulsion side should be in contact with the page. This surface can be detected by picking the film up by one corner — it will curl towards the emulsion side. Exposures of about 20 minutes are normally necessary.

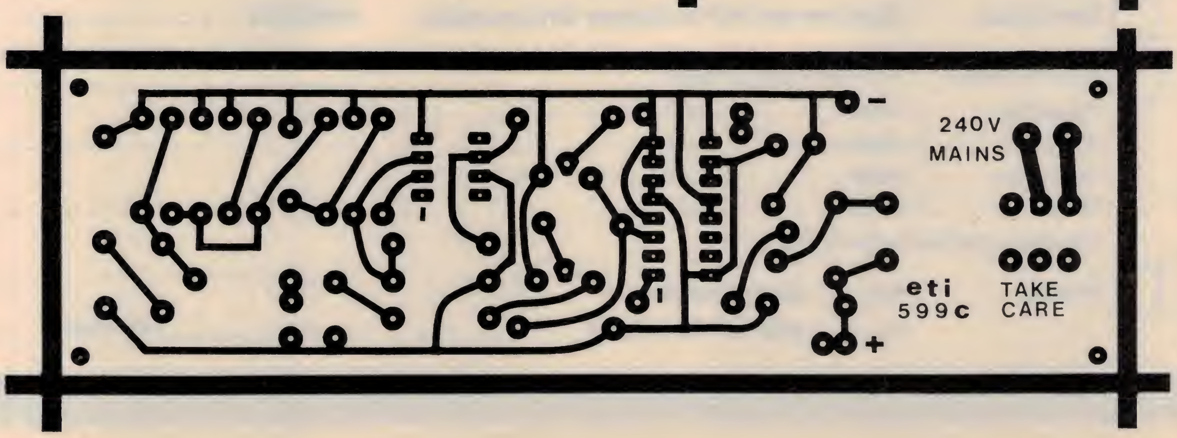
The film can now be developed by placing it emulsion side up on a table, pouring some Scotchcal 8500 developer on the surface and rubbing it with a clean tissue.

Further information on Scotchcal and pcb manufacture can be found in the September and December 1977 issues of ETI.

Please note that occasionally lack of space may prohibit the printing of blue type behind all pcb's. In this case the reader must resort to more conventional photographic techniques for pcb manufacture.







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The other half of the team, the 65W F55 Amplifier, features an electronic motor driven volume control, straight signal processing circuit construction, revolutionary Heat Pipe, and Pulse Power Supply, providing extremely clean and noise-free sound quality.

The F55 operates with almost any type of MC and MM cartridge; has gold-plated phono jacks, oxygen-free copper wiring, metallized film resistors and polypropylene capacitors.

You won't find better engineering than these. Not even from Sony.

TA-F55

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Philips — the giant slumbers no more

Although Philips in theory has a lead of more than a year in the video systems war, their showing in the market as yet has been less than startling. However, according to Dennis Lingane, who recently visited their head office in Eindhoven, Holland, Philips now has a much more aggressive market strategy planned, and has no intention of coming out second-best in electronics' most lucrative future market.

Basically, Philips has to make a stand — and fast — against the Japanese domination of the video market with their VHD (Video High Density) system.

Although senior executives at Philips are a little shy about using the word aggressive, they are very willing to admit that we are going to see a far more "positive" approach to marketing video this year. The apparently sleeping giant is about to stir and take the world by storm!

The move to buy Philco and Sylvania in the US was part of this new positive approach; the takeover gives Philips 15% of the US television market and makes them the third largest manufacturer in the US — an ideal basis on which to launch their video recorders. It also makes Philips, with its European production, the undisputed biggest television manufacturer in the world.

According to Harry Renkels, head of the television division, if Philips does not get its share of the video market, it could see its position in the TV market eroded. It is naturally not about to stand around and see this happen: "We have the resources and we will use them. In the future only the large companies with massive research programmes will survive. Philips has the necessary research facilities, but we lacked the distribution network and manufacturing facilities in the US. Now we have those.

"In the past we were not aggressive to the outside world. We were modest. But now we will be more positive."

The first exercise will be to launch the Philips eight-hour flip-over-cassette video recorder on to the world markets. Head of video, Bill Tuinder, says that Philips is quickly gearing up its production of the recorder in Europe. Two factories in Vienna and one in Germany will be pumping out 700 000 machines by the end of 1981, and the plan is to double this production capacity each year until Philips is producing 2.5 million players a year by the end of 1983. This doesn't take into consideration Grundig's production, nor the production capability of the ten partners that have signed with Philips to produce the recorders and the six that have signed with Grundig. So Bill Tuinder has no doubt that the Philips video recorder will become the European market standard.

Because of the PAL system, Australia is likely to take its standard from the European system anyway, but Philips nevertheless recognises the need to make big inroads in a hurry into such traditional markets as Australia, South Africa and the Arab countries, as well as into the US market.

Bill Tuinder says that we will see a big launch of the Philips video recorder on to the Australian market "in the near future. There is no point in coming in with a handful of machines this month and a handful next. We are planning a big launch and will have a range of models, including a portable, that will suit the needs of that market. We would have liked the new machines a year or two earlier, but even so we are not too late . . . We are well established in the TV market and this will enable us to get our share of the market."

Pocket TV features LCD screen

This 'pocket' portable TV receiver had its first public showing outside Japan at Toshiba's 1981 'Star of the 80s' launch of their video products back in February. Featuring a liquid crystal screen about 50 mm wide, the unit is a battery-operated monochrome receiver and is, as yet, only in prototype form, but Toshiba expect to have models on the market later this year or early next year. Demonstrations at the Toshiba launch function were done using output from a VCR. Mr. S. Komiya, a Toshiba R & D engineer, is shown here with the unit he developed. (Picture by Michael Andrews).

So the launch in Australia will take place only when there is a good stockpile of machines in a suitable range, and also when there are enough blockbuster movies ready in the Philips cassette system. A contract has been signed with Magnetic Video in the UK, which will automatically lead to supplies for Australia.

"We will have to push our way into the market in the first year," says Bill. "It may be difficult, but we are determined, even though it may cost us some money. But we are big enough."

He says that the top-of-the-range video cassette recorder will match the Sony C7 recorder in price and features, and it will head a full range, all competitively priced.

Meanwhile Bill Zeis, the exuberant and dynamic leader of the videodisc operation, is supremely confident of the success of the optical videodisc. He reckons RCA and VHD manufac- ▶

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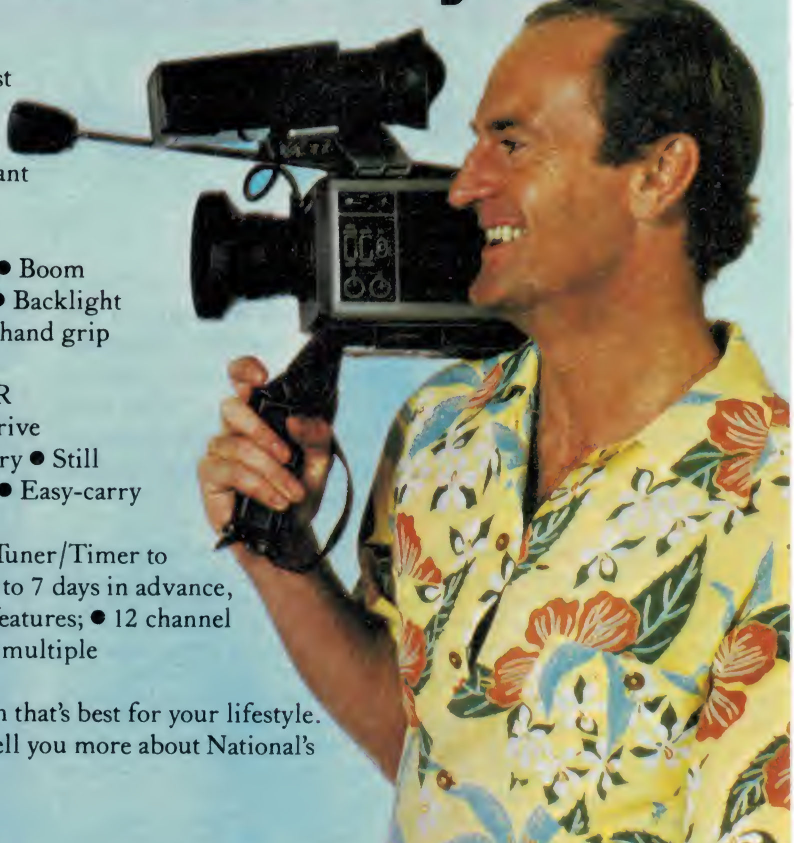

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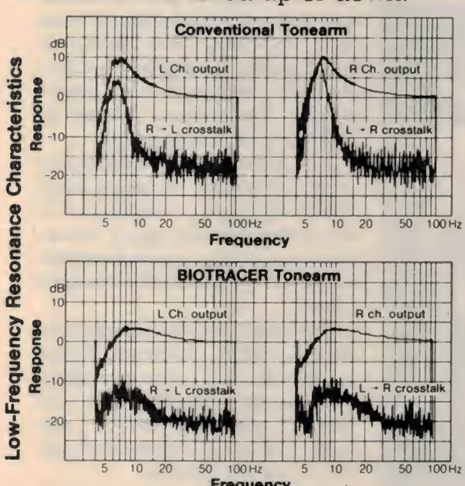
Biotracer has dismissed tonearm resonance. Those wayward harmonics that used to break up the romance between the listener and his music. By combining a microcomputer, velocity sensors and three linear motors in the tonearm to control every movement. All unnecessary tonearm movement caused by its own resonance or eccentricities in a record, like warping, are immediately detected by horizontal and vertical sensors. A microcomputer responds to the slightest variation and directs Biotracer's linear motors to compensate.

Sound reproduction is clear. Rich bass is richer. And high frequencies more brilliant.

All other turntable functions are also automatically orchestrated by the microcomputer. Record selection is automatic. So is repeat, lead in and out, and even stylus muting whenever it is lifted up or down.



A linear torque BSL motor, together with a quartz crystal lock and Magnedisc servo system, assures stable speed and precise platter rotation.

PS-X75

The PS-X75's cabinet is made of of SBMC (Sony Bulk Molding Compound) to stifle howl. And gel filled insulators absorb acoustical energy and prevent feedback between turntable and speakers.

And Sony has paid attention to the little things. Like convenient total front panel operation including stylus force adjustment when the dust cover is down.

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The new PS-X75 turntable with Biotracer. A new year for your music.

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AP3527

Sight & Sound news

turers are in for a shock. "After two years in the marketplace we are over the learning curve and on the way up. They are entering the learning curve and they don't know how deep are their valleys."

One of the criticisms aimed at the optical disc manufacturers is their apparent inability to solve their software production problems. Bill Zeis admits that these problems existed, but claims that they are now over thanks to Philips and Pioneer.

Pioneer Electronics has apparently made some important breakthroughs in the development of software production, and this information has been handed over to Discovision, IBM and MCA Universal's disc manufacturing company. Discovision owns 50% of Universal Pioneer, which manufactures the videodisc players in Japan. Meanwhile, Philips has developed a photopolymisation system for disc production which has not only solved production problems but is cheaper to boot.

Bill Zeis says that contrary to reports Philips does not have a joint company with 3M in the USA. "We co-operated with them to help them build a software factory and provided the plant for it, but that is all. They are operating completely independently of us."

When asked about the shocks he claims RCA and the VHD disc manufacturers are in for, he says that they underestimate problems associated with the production of software.

"It is utter nonsense and absolutely ridiculous for these people to say that their discs can be produced in a traditional audio disc factory. Making a video disc, whether it be VHD, RCA or optical, is a very difficult process. It can be compared to producing an integrated chip. It needs the same precision and discipline. Sure it is difficult to make optical discs, but I am sure that when they start they will find it is just as hard to make any videodisc, whether it is optical or capacitance. It is easy to make a disc in laboratory conditions. But making discs in a mass production situation with a high-quality yield of 95% is quite another matter."

Philips' own factory in Blackburn, England, is meanwhile off and running. Discs are being stockpiled there for the launch of the Philips videodisc player later this year. The date is being kept secret, but it should be in the middle of the year, according to Zeis.

When will we see the videodisc in Australia? When a software factory is operational in Australia making discs.

"This is a software market," says Bill. "People don't buy a videodisc player just to have one, they want to see the latest blockbuster movies on their televisions, and they want to be able to buy the films when they feel like it, which means a wide distribution of a large range of titles from D-Day." He added that talks are already under way with a company to build a software factory here, so all we can do in Australia is wait for this 'D-Day' — hopefully in the not too far distant future.

Dennis Lingane

Rumours, rumours

We hear from a usually reliable source that you'll soon be able to get Dolby noise reduction in car sound equipment.

It seems US car sound leaders Fosgate showed a system featuring Dolby at the US Winter Consumer Electronics Show in Las Vegas recently. An interesting development . . .

Give your video movies that 'professional' touch

Video Classics has released a new, low cost video tape labelling system designed to give your video tape recordings a neat, professional look.

For just $10.95 recommended retail you get a kit that contains everything you need to label and organize tapes.

The 'Video Organizer' is a complete labelling kit that contains twenty vinyl sleeve covers that adhere to the jacket sleeve, and two sheets of vinyl lettering and decorative borders. A range of decorator colours is available.

The kit also includes a stay-put guide for centring and a special lettering tool to ensure correct positioning, a re-sealable container with step-by-step photographic instructions and helpful hints and ideas.

'Video Organizer' is available now in three colour combinations anywhere video tapes and accessories are sold.

50% off blank cassette tapes?

Dindy Sound Warehouse is a direct marketing Company which offers a wide range of quality cassettes at greatly reduced prices.

You order direct from the company, which delivers the tapes to your door. The Dindy cassettes are Australian made and offer a complete range of lengths and grades.

Top of the line is the Dindy Chrome which sells for $2.99 in C90 length — almost half the normal retail price of quality chrome tape.

Next in line is the Dindy Diamond, an ultra-dynamic quality tape, then the Hi-Energy and the Dindy Super low noise tapes, all at up to 50% off the retail price of similar quality tapes, Dindy claim. The tapes carry an unconditional five-year warranty.

More information and a free sample tape can be obtained for a $1 cheque or money order (to cover post and handling) from Dindy Sound Warehouse, P.O. Box 55, Rushcutters Bay NSW 2011.

You're the master, not the slave

You can be the master of your TV instead of its slave, according to Toshiba, with their new Beta format V-5470 VCR. Apart from the basic record and playback functions, the V-5470 allows you to record the programme on one channel while you're watching another.

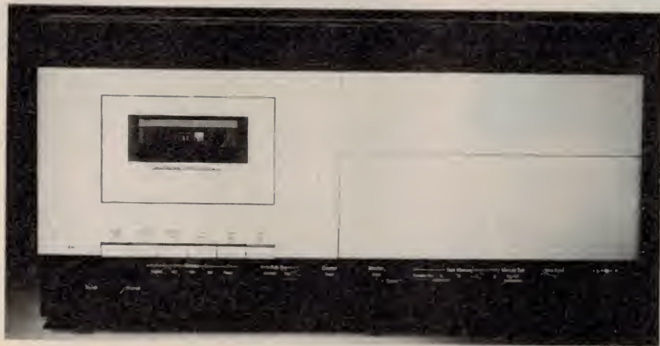
You can set it to record programmes in your absence — including a series of programmes at different times on different days.

That's all pretty familiar stuff, but Toshiba have more up their sleeve. First, there's the audio dub facility. This allows you to get in on the act and add voice or background music to a recording. Then there's the programme quick-select function. In either fast-forward or rewind modes, this function locates the beginning of a programme.

The picture-search function is the unit's top feature. This allows you to search through a recording at 20 times the standard speed, forward or reverse. When you find what you want, you simply switch to standard speed.

Together, the picture search and speed control functions provide complete control over a recorded programme, Toshiba say. Still frame, frame-by-frame, slow motion and fast motion are available at your command.

Recommended retail price is $1200.



700ZXL — new Nakamichi!

Nakamichi say their new 700ZXL is a 'novel' cassette deck — and it seems an apt description!

The auto-calibration ("ABLE") and random access music memory ("RAMM") of the previously introduced 1000ZXL model are included in the 700ZXL and Nakamichi say the new machine continues the design policy of the model 700 II, which has received world-wide acclaim for its unique design and top-notch performance.

The 700ZXL employs a discrete three-head system. The playback head has a crystalloy core with a 0.6 micron gap, reducing playback loss of high frequencies and yielding a flat frequency response to the top end of the audio range.

In addition, Nakamichi claim that, by improving the head shape and structure, the so-called 'counter effect' at low frequencies has been done away with as well as providing a response down to 18 Hz!

The record head has a crystalloy core with a 3.5 micron gap while the erase head combines a ferrite core with a sendust tip of high flux density. Nakamichi say its double-gap, super-miniature design prevents energy loss and yields very high erasure efficiency.

Naturally, the 700ZXL uses the Nakamichi-developed diffused-resonance, double-capstan tape transport.

Twin bargraph LED level displays cover the range from −40 dB to +10 dB and incorporate a peak hold function which is automatically reset after six to seven seconds.

The 700ZXL incorporates double Dolby noise reduction system permitting Dolby encoding and decoding simultaneously. Special input and output jacks on the rear panel permit connection of an external nr system, such as Nakamichi's HiCom II.

To preserve the "uncluttered beauty" of the 700ZXL's front panel, the less frequently used switches and controls are hidden behind a sealed panel. Naturally, a remote control unit is available.

Whetted your appetite? Full details from Convoy International, 4 Dowling St, Woolloomooloo NSW 2011. (02)358-2088.

Expansion for KGC

KGC Magnetic Tape Pty Ltd, self-styled as 'Australia's leading independent manufacturer of pre-recorded cassettes', is planning an extensive expansion programme this year.

KGC have already purchased more duplicating and cassette loading machines, and will be acquiring other new specialised electronic equipment as well as possibly moving to larger premises.

According to KGC, demand for pre-recorded cassettes has now outreached capacity, and the company expects to be able to increase their tape duplicating by approximately 50% during 1981 to meet this rising demand.

These moves follow the acquisition of the company by the Rigby Group.

For further information contact Bill Gordon, General Manager, KGC Magnetic Tape Pty Ltd, 40 Applebee St, St Peters NSW 2044. (02)519-2677.

Keep your nose . . . er, heads, clean

The precision heads in your video cassette recorder need to be kept clean, just like the heads in your audio cassette deck.

A unique VCR cleaning cassette has been produced by the US company Allsop, makers of the famous 'Allsop 3' audio cassette deck cleaning cassette.

The Allsop 3 Video Cassette Cleaner contains a chamois cleaning tape inside a standard VCR cassette assembly, and like its audio cassette forerunner, the whole cleaning action is driven by the machine itself.

You place the Allsop 3 VCR Cleaner in the machine and press the play button. The cleaning chamois is then drawn out of the cassette and driven around the video and audio heads, removing foreign particles but not abrading the heads, according to Allsop. A felt pad presses on the capstan and pinch roller and cleans these components as well. The cassette shuts off the recorder after the cleaning action is completed.

A specially-formulated cleaning fluid is used on the chamois and felt pad. The assembly in the cassette and the felt pads are replaceable.

The Allsop 3 VCR Cleaner, model 60800, suits VHS machines and is available from video outlets for around $35; replacement cartridges cost around $10.

We understand a model to suit Beta format machines will be available shortly.

Full details from the sole importer, CPI Inc., P.O. Box 246, Double Bay NSW 2028. (02)357-2022.

World's smallest colour camera ?

Measuring a tiny 58 mm wide by 100 mm high by 155 mm long, Hitachi's new colour camera, the VK-C 1000, weighs just 1.1 kg, including its 6x power zoom lens system.

Claimed to be the smallest colour home video camera in the world, it employs a single-chip MOS image sensor less than 20 mm square manufactured using advanced VLSI technology. Hitachi say the VK-C 1000 is especially suitable for outdoor use.

Images are obtained less than half a second after switching the power supply to the camera and power consumption is quoted as just 3.8 watts! Resolution is given as 260 lines horizontally, 350 lines vertically and video signal-to-noise ratio as 46 dB.

The camera can be used down to 100 lux, Hitachi say. An f1.4 lens is employed, together with an electronic viewfinder.

The VK-C 1000 is expected to be marketed first in Japan from this month, priced at around A$1400, followed by a later release to the overseas market.

Brian Dance

RARE ADDITIONS FROM MARANTZ. SLIMLINE COMPONENTS.

Rāre: very valuable.
Addi'tions: the things added.
Ma'rāntz: a range of ultra-high performance Slimline Components which blend state-of-the-art engineering with operational versatility.

MARANTZ ST450
AM/FM STEREO TUNER

Electronic Gyro-Touch tuning and digital display enable precise and speedy station selection which can be servo-locked for drift-free operation.

MARANTZ EQ20
STEREO GRAPHIC EQUALIZER

Beautifully styled, the EQ20 provides highly personalised tone control flexibility with its ten detented slide controls per channel – the perfect finishing touch to any high quality audio system.

MARANTZ SC500
STEREO PREAMPLIFIER

Traditional Marantz performance in the all important first stage of amplification. Moving coil cartridge head-amp and different cartridge load inputs are just two of the comprehensive number of facilities.

MARANTZ SM500
DC POWER AMPLIFIER

Perfectly complements the SC500 and delivers 50 watts RMS per channel. Output is displayed on two large, peak responding power level meters.

MARANTZ PM350
INTEGRATED AMPLIFIER

Bass, mid and treble controls and LED power level meters, combined with an output of 30 watts RMS per channel, make this the ideal amplifier for normal listening levels.

MARANTZ SR1100
AM/FM STEREO RECEIVER

Slim, stylish and component width, the 30 watt RMS per channel SR1100 provides a new concept in compact audio sophistication.

MARANTZ SD5010
STEREO CASSETTE DECK

Forerunner to a new generation of superior cassette decks, the SD5010 has soft-touch controls, LED meters, metal tape facility, fine bias control and an electronically controlled linear skating mechanism operating the cassette drawer.

Shown are but a few of the new Marantz Slimline Components. If you see your hi-fi as an investment and, if you demand critical performance standards as well as the best value for money, listen to the future.

Listen to Marantz.

marantz.
Now you're listening.

Distributed by MARANTZ (AUST.) PTY. LTD.
P.O. Box 604, Brookvale, N.S.W. 2100
Telephone: (02) 939 1900 Telex AA24121
Melbourne (03) 329 7655 Brisbane (07) 446 478
Adelaide (08) 223 2699 Perth (09) 276 2944

The KX-500: easy operation, Dolby noise reduction, metal tape capability

One finger exercise

The joy of owning a hi-fi cassette deck is in being able to record broadcast music, as well as friends' records, with similar quality to the original.
You can build up an extensive library of taped music ready to impress your guests on every conceivable occasion.
Trouble is, many top quality decks are pretty complicated to operate. Especially when it comes to "tuning" a deck to a particular type of tape. Enter the Kenwood KX-500!
It doesn't take much effort to put this deck in the right mood to record—and play—tapes of unsurpassing beauty.
You can use the latest metal tape easily. And reap the rich rewards of its superior recording characteristics. There's also Dolby* noise reduction to remove hiss from the tape.
To start recording takes literally one finger. Instead of the usual, awkward two-finger exercise.
Fast-action fluorescent meters warn you of music-energy climaxes. While logic simulated controls respond instantly to the merest touch.
Naturally, the KX-500 performs like a professional.
And that, after all, is the main advantage of choosing to live with Kenwood hi-fi equipment.

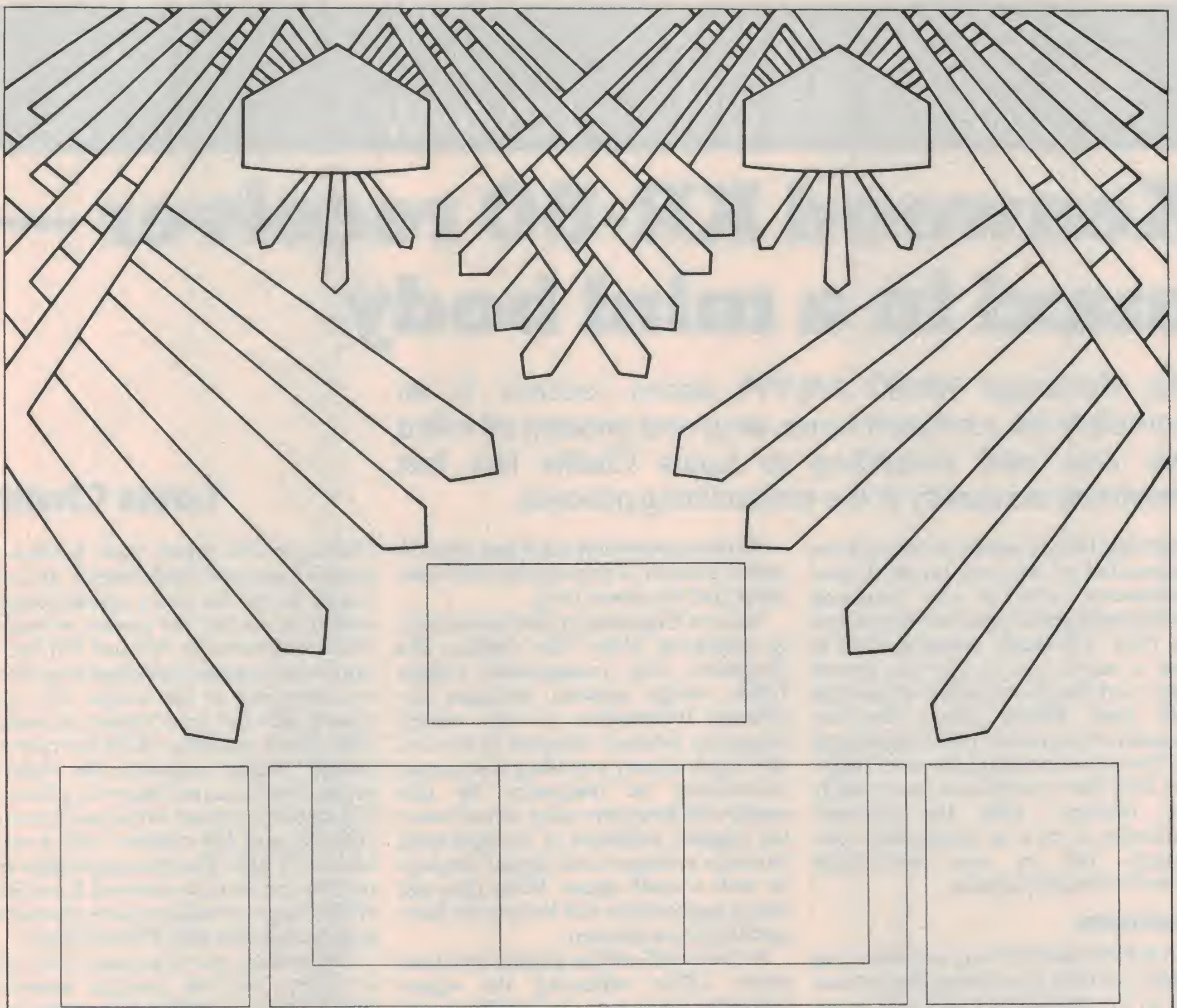
*Trademark of Dolby Laboratories

Metal Tape

W/F 0.05% (WRMS). S/N 64dB. Frequency Response 30Hz to 16,000Hz.

KENWOOD

TRIO-KENWOOD CORPORATION
(NEW ADDRESS) Shionogi Shibuya Building,
17-5, 2-chome, Shibuya, Shibuya-ku, Tokyo 150, Japan
TRIO-KENWOOD (AUSTRALIA) PTY. LTD.
30 Whiting St., Artarmon, N.S.W. 2064, Australia Tel: 439-4322



Introducing the Bose® 901® Series IV system. It performs as well in the living room as it does in the demo room.

The new Bose 901® Series IV Direct/Reflecting® speaker has a new equalizer with two controls that let you adjust for various room acoustics and speaker placements. So it sounds as well in one room as it does in the next.

In addition, there is a new driver, so advanced in materials and design that Bose has removed all power limitations for home use. Yet you can drive these speakers with as little as ten watts per channel.

With the Bose 901® Series IV you can put together a system that gives you life-like, spacious sound for a fraction of what it would cost to get the same sound with any other speaker.

BOSE®

111689-9/78-15

sound review

Kenwood KR-80 receiver — maxi in a mini body

The Kenwood KR-80 AM/FM stereo receiver is an incredibly flat, compact tuner, amp and preamp all rolled into one, and according to Louis Challis has lost absolutely no quality in the streamlining process.

Louis Challis

IN SOME OF my recent reviews I have commented on the new range of mini components which is now becoming increasingly popular in both Japan and the USA. Obviously somebody had to steal a march and change the ground rules, and Trio Kenwood have done this with their KR-80 Stereo Receiver. Instead of two or three mini components for the tuner, preamplifier and amplifier, they have created one inordinately flat receiver with the physical attributes of two or three mini components but in one particularly attractive single package.

Features

The KR-80 receiver may not have won prizes yet from any design competition but in my opinion it could well do so. This is without a doubt one of the neatest and most exceptional receivers that I have yet tested. The attractive linear display, which extends right across the top of the brushed satin aluminium escutcheon, provides both analogue and digital data, frequency selection, signal strength, mode selection and power output level through a range of light emitting diodes and illuminated digital frequency displays in a most ingenious manner.

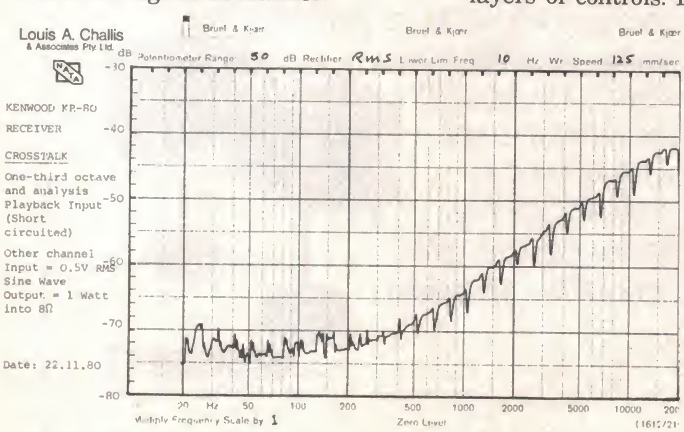
At the extreme left hand end, over the power selector, a rectangular LED indicates that the power is on.

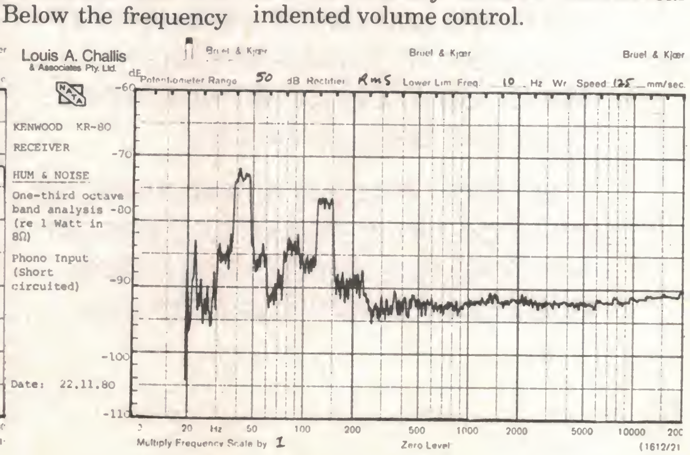
Above a frequency graticule externally engraved below the display, the designers have incorporated sixteen LEDs, which provide analogue positional information on the station frequency selector. Adjacent to this is a four-digit display providing more exact information on frequency. By this means the designers have solved one of the biggest problems of incorporating both the analogue and digital displays in such a small space. What they did was a compromise, but the results have justified their decision.

In the middle of the display are three green LEDs indicating the signal strength; there are even gradations in illumination to indicate gradations in signal strength. To the right of these is a red LED to signify stereo selection, whilst above the AM/FM and phono selectors are large rectangular red, green and yellow LEDs. Lastly, on the extreme right hand side are five LEDs to signify power output levels of .01, .05, .5, 5 and 35 watts respectively into 8 ohms.

The escutcheon is divided into two layers of controls. Below the frequency LEDs are five preset push buttons, a memory activate push button, an auto tuning rocker bar and a manual tuning switch to control the station selection. The five presets for AM and FM maintain their frequency selection even when not connected to the mains. The auto tuning searches for a station of acceptable signal strength, whilst the manual tuning button connects the manual tuning knob located below it, allowing FM stations to be set with a resolution of 100 kHz and AM stations with a resolution of 1 kHz. The other controls in the top row are for tape selectors A and B to either play or monitor source, plus three push buttons for AM, FM and phono.

The bottom row of controls, from left to right, are two speaker selection switches for A and B, a bass, treble and balance control, the manual tuning control, and a high filter on/off selector switch. To the right of these are the loudness selector switch, a mono/stereo/FM selector switch and a microphone mixing potentiometer. This controls the level of signal that can be fed into the preamplifier stages from a tip-and-sleeve microphone socket located on the front panel. The last control is a large and functionally sensible mechanical indented volume control.





The rear of the receiver incorporates screw terminals for the FM and AM antennae, a single pair of sockets for a moving magnet phono cartridge input, two pairs of sockets for two pairs of tape recorders, an FM de-emphasis switch so that either 50 μs (for Australia) or 75 μs (for the USA) may be selected.

The well-designed AM loop antenna is removable from its hinged bracket for more suitable positioning. The unit incorporates a pair of switched and unswitched sockets which do not meet Australian standards, and four pairs of screwed universal sockets for connecting two pairs of loudspeakers. The unit also has a socket for connecting an external programme timer so that the unit can be automatically switched on and off as required.

On the bottom of the receiver is a selector switch whereby either long range or local reception can be selected in the presence of a strong local station.

The inside of the receiver is exceptionally neat, with the minimum amount of interwiring connections, virtually of all of these being in the form of flat ribbon cable — which maintains an unusually clean appearance and simplifies fault-finding and maintenance.

The unit contains four printed circuit boards, the two largest ones being the FM/AM tuner on the right hand side and the audio and rectifier stage on the left hand side. The main power transformer sits between these with the fuses and dc power regulator located at the rear. The digital indication section with the phase-locked loop crystal control circuitry is located on a sub board above the two main boards, immediately behind the digital display. Another minor board located adjacent to this controls the operation of the linear LED display for the quasi analogue frequency display section.

The designers have very carefully designed the total layout so that the low level RF section stage is adjacent to the aerial terminals and a logical signal sequence path is maintained throughout the whole of the system.

The power output stages are large-scale integrated circuits connected to an unusual fabricated folded heatsink, which forms the whole left hand end of the chassis. The top panel is sensibly perforated in the correct position as is the bottom panel, allowing adequate ventilation for the expected thermal dissipation.

The unit is well finished and very well presented, and would fit easily on a shelf, inside a bookcase or on top of a normal piece of furniture.

On test

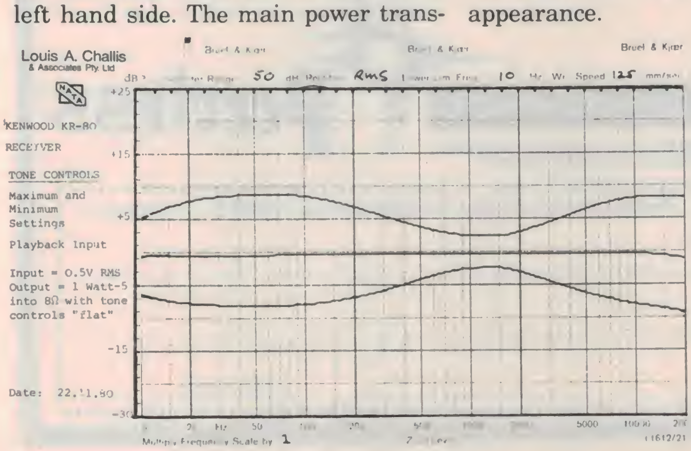
The objective testing of the unit proved that the manufacturers have gone to as much trouble with the technical performance as they have with the appearance.

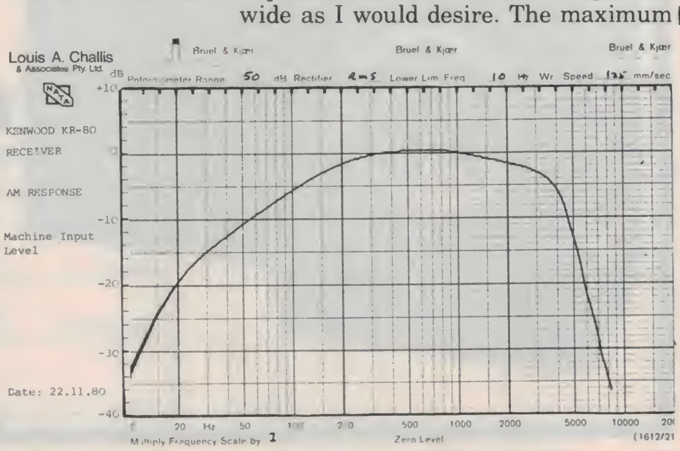
The frequency response for the tone controls centred is 1.2 Hz to 42 kHz; the phono sensitivity is typically 500 μV with overload at 155 mV; the harmonic distortion at rated power of 27 W is less than .016% and at 1 W is less than .012%. The transient intermodulation distortion is way below 0.1%, whilst the hum and noise levels on playback are −84 dB(A) for auxiliary input and for phono input −80.5 dB(A) reference the 1 W level. The power output of 27 W has a 1.6 dB dynamic head room whilst the crosstalk is −65 dB at 1000 Hz and −42 dB at 20 kHz.

The tone controls provide only a moderate ±7 dB cut and 8 dB boost, whilst the loudness control exhibits useful though not exceptional operation.

The FM section gives good performance in reasonable agreement with the manufacturer's stated figures. The actual figures are 20.8 dB(F) for a mono signal to noise ratio of 26 dB, and 26.7 dB(F) for a stereo signal to noise ratio of 46 dB. The FM stage's frequency response is 27 Hz to 15 kHz, whilst the channel separation is better than 35 dB at mid frequency.

The AM receiver sensitivity is 4 μV for 6 dB signal to noise ratio and 170 μV for 26 dB signal to noise ratio. The AM bandwidth is a reasonable 130 Hz to 6.5 kHz, which is better than most other Japanese receivers but still not quite as wide as I would desire. The maximum ▶





SOUND review

MEASURED PERFORMANCE OF KENWOOD KR-80 RECEIVER

HARMONIC DISTORTION:

(A) (At Rated power of 27 Watts into 8 Ω= 14.7 Volts)

	100Hz	1kHz	6.3kHz
2nd	-76.8	-91.1	-dB
3rd	-83.6	-92.0	-88.7dB
4th	-92.5	-	-dB
5th	-99.0	-	-dB
THD	0.016	0.0037	0.0037%

(B) (At 1 Watt into 8 Ω)

	100Hz	1kHz	6.3kHz
2nd	-79.4	-84.4	-80.3dB
3rd	-86.3	-98.8	-84.9dB
4th	-98.3	-99.4	-86.0dB
5th	0.101.1	-100.1	-dB
THD	0.012	0.0063	0.012%

TRANSIENT INTERMODULATION DISTORTION:

Very low less than 0.1% (3.15kHz square wave and 15 kHz sine wave mixed 4:1)

NOISE & HUM LEVELS:

re 1 Watt into 8Ω) PLAYBACK -73.5 dB (Lin) -8.4 dB(A)
(with volume control set for
1 Watt output with, PHONO M/M -69dB (Lin) -80.5 db(A)

0.5V input (Playback)
5mV input (Phono M/M)

MAXIMUM OUTPUT POWER AT CLIPPING POINT:

(IHF - A - 202)
(20mS burst repeated at 500mS intervals) 50 V P-P
= 39 Watts
Dynamic Headroom = 1.6 dB (re Watts)

FREQUENCY RESPONSE: Tone Controls Centred

(-3dB re 1 Watt, 0.5V Input to Aux)
Left 1.2Hz to 42kHz
Right 1.2Hz to 44kHz

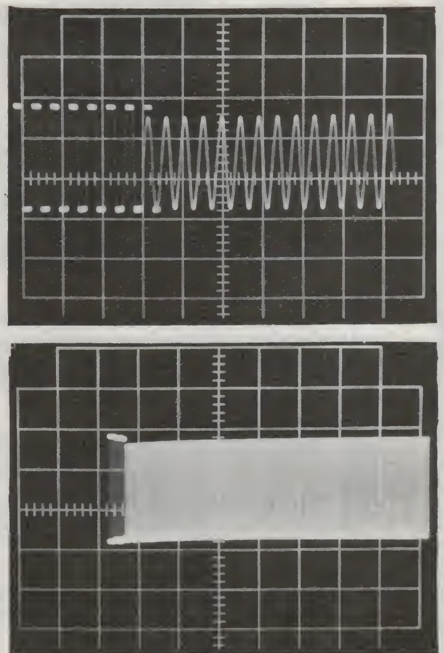
SENSITIVITY:

(for 1 Watt in 8 Ω)		Left	Right
	TAPE	29mV	28mV
	PHONO M/M	480 µv	500 µv
	OVERLOAD M/M	155mV	162mV

INPUT IMPEDANCE:

	Left	Right
TAPE	45kΩ	44kΩ
PHONO	47kΩ	47kΩ

OUTPUT IMPEDANCE: 84 milliohms (@ 1kHz)



Transient overload recovery test (IHF-A-202). 10 dB overload re rated power into 8 ohms — both channels driven. Top photo 2 ms/div., bottom photo 50 ms/div.; overload duration 20 ms; repetition rate 512 ms.

signal to noise ratio on AM is 49 dB.

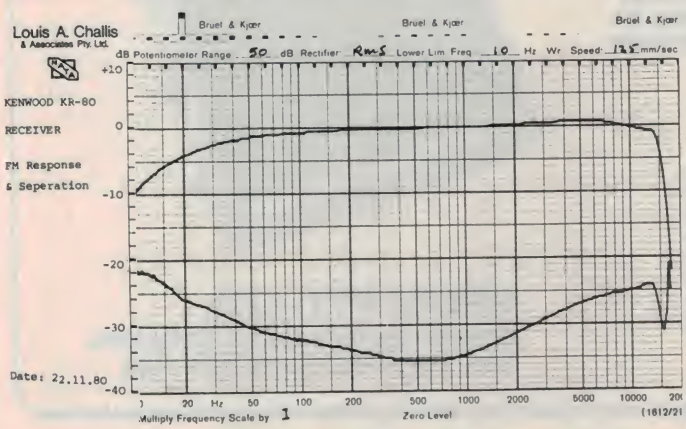
Overall the RF performance is good, considering that this is a synthesised receiver bereft of the advantages of a radio frequency stage which usually 'separates the men from the boys'. (For those of you who are unfamiliar with the term 'Radio Frequency Stage', this is a stage of amplification and selective tuning performed at the frequency of the incoming signal. It provides higher selectivity and sensitivity and is an essential feature if one lives in an area with low signal strengths, or experiences problems of multi-path reflections.)

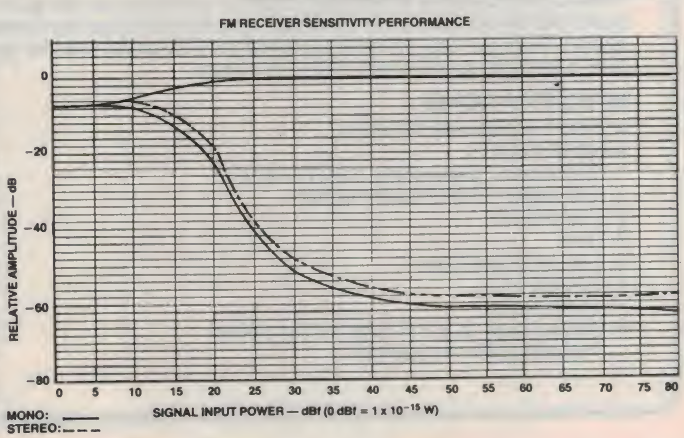
In practical use at home the FM section proved to be remarkably clean and functionally a delight to use. Both the family and I enjoyed using this receiver for FM reception, with a cassette player and record player, and even on AM. Playing the Kenwood KR-80 with a set of Quad electrostatic speakers fed by a turntable fitted with a Shure V15III or a new Audio Technica AT 155LC cartridge, the audio stage provided a truly impeccable performance. The assessment showed that this system is at home both in large rooms and very small rooms with dimensions of only 27 m^3.

The Kenwood receiver is not cheap and there are many receivers which are bigger and cheaper; hopefully readers don't buy receivers simply because of their price or judge them by their size. This is definitely one receiver in which small size is a positive attribute that perhaps initially hides the quality of performance and the excellence of its ergonomic and technical design. ●

KENWOOD KR-80 RECEIVER

Dimensions:	*440 mm wide x 336 mm deep x 78 mm high*
Weight:	*6.1 kg*
Manufactured in:	*Japan by Trio Kenwood*
Price:	*$565.00*
Distributed by:	*Trio Kenwood Australia*





AUDIO CASSETTES

DIRECT FROM FACTORY
HEAT RESISTANT SHELL

HEAT RESISTANT CASE
All of our cassette cases are made of polycarbonate and not conventional plastic. Polycarbonate is very strong and will withstand extreme heat in excess of 200ºF and can be safely used in all high temperature areas such as cars and outdoors without expansion, cracking, warping, or buckling taking place.

TAPE CHARACTERISTICS
(a)Our standard ultra dymanic cassettes are loaded with wide range tape that has extremely good response curves and will give excellent results.
(b)Our Grand Mastering tape will give super dynamic range and is ideal for mastering or any application where absolute top quality is required.

NON ABRASIVE TAPE
Both tapes used are highly polished and non abrasive and will not shed oxide on your heads, this means increased life and increased head life.

BIAS AND EQUALISATION
Our standard ultra dynamic tape and the Grand mastering tape both operate with normal 120u SEC Equalisation.

GUARANTEE
All cassettes are guaranteed against faulty workmanship and material and will be replaced.

ACCURATE TRACKING
The corrugated liners ensure perfect tracking and minimise vertical tape travel resulting in excellent azmuth alignment and better suspension.

SCREWED CASE
The rollers are supported by stainless steel pins which have been lubricated, and the case is fastened with stainless steel screws. Because of the new design the case is whisper quiet in operation.

ITEM	1-9	10 & Over	TOTAL
Ultra Dynamic C60	$1.40	$1.30	
Ultra Dynamic C90	$1.90	$1.70	
Grand Mastering C60	$1.90	$1.80	
Grand Mastering C90	$2.40	$2.20	
Postage 1-9 — 50c	10& Over — $1.00		
		TOTAL	

I enclose cheque/bankcard for $

4	9	6											

Name...

Address...

Postcode ....Signature ....

QANTEM

AUDIO ELECTRIC PTY. LTD.
PO BOX 72 STH. OAKLEIGH 3167 PH (03) 544-7301.

Attention all colour TV technicians

At last we are proud to announce a new pocket size PAL TV COLOUR PATTERN GENERATOR.

GENERAL INFORMATION

The TV COLOUR PATTERN GENERATOR, PAL MC-11 B, was intended to be used for control services, installations and repairing of TV sets C.C.I.R. in PAL colour and in the black and white, B and G systems (or I system).
In order to control and adjust the various parameters of the colour TV sets, the MC-11 B has eight adjustment patterns for screen observations.
The technician always has access to the services of this instrument in both the laboratory and in the clients home.
The MC-11 B is a small size pocket generator which one can always have on hand, and thanks to it's autonomic feeding by the nickel cadmium battery, it is always ready for use. An adaptor/recharger is supplied with the generator plus a connecting cable and a Ni-Cad battery.

SPECIFICATIONS

- Output impedance: 75 ohms.
- Signal Pattern:

1. Colour bars. Grey scale in B/W position.
2. Red raster. Grey in B/W position.
3. Crosshatch.
4. Dots.
5. Central single cross.
6. Central dot.
7. White raster.
8. Vertical lines at 2,217 Mhz without sound (half subcarrier frequency).

NISSIM PTY. LTD.
249-251 Carlisle Street, Balaclava, VIC. 3183. Phone (03) 527-7146.

Thrust and parry in the video war

A strange market quirk — or a smart move by Sanyo, depending on your standpoint — put the Beta video cassette format up front on the Australian market in contradiction to the rest of the world. But the battle between the Beta and VHS formats is not over. There are fresh fields to conquer. Our man at the front reviews the battle lines.

Dennis Lingane

THE ELECTRONICS INDUSTRY has become ferociously engaged in the bitter video cassette war — possibly to its own detriment, and possibly also to the detriment of the consumer. Until recently, development and manufacturing was a very controlled market; it had to be. When a company spends $100 million developing something like a video cassette recorder, it must program its life on the market-place to give the company a return on its investment. However, in the video cassette war all reason has been abandoned, and the various proponents of the different systems have poured new models on to the market before the old ones have barely had time to get run in. All of which is rather depressing for the consumer who buys a machine today only to find it's an obsolete model tomorrow.

While the market may now accept that both VHS and Beta are here to stay, and that Philips' flip-over eight-hour format system may never get off the ground outside Europe, the war is far from over.

National Panasonic and Sony, the main contenders in this war, may have played their trump cards in their current home models, but there is still a battle going on because the war ain't over yet.

I personally think that National Panasonic's top-line NV7000 video cassette recorder was not due out for several years and that National released it late last year to counter the Sony C7. Both are top-drawer units featuring infra-red remote control, but Sony's C7 has a speed search system and National's NV7000 offers Dolby on the audio. Apart from those obvious attractions, both offer a wide range of function and control features.

No, it's not a weapon in the video war, but it's certain to become involved in the battle! The picture shows JVC's zoom mic that clips onto your video camera so you can zoom in on the sound when you zoom in on the picture.

To my mind, the thing that was bugging National was the way the Australian public leapt on the Sanyo Betacord machine that was offered at an all-time low price of $799. That Betacord splash by Sanyo not only clobbered the price level of video recorders in the market-place, it also put Beta right up there ahead of VHS as the people's choice.

It hasn't happened anywhere else in the world. VHS leads Beta in the USA, Japan and Europe by a ratio of around 7:3.

Seeing its grip on the Australian market slipping after the Betacord price-slash, the VHS camp was forced to take action. Some of the precious stock that had been pouring into the lucrative European market was re-routed to Australia, which usually gets only the crumbs from the Nippon table because we are so insignificant as a market (two per cent of the Japanese export market).

Sharp took the Betacord head on with its front-loading model 7300 that sells for that 'magic' $850. Meanwhile, National fought Sony on the deluxe market. With both companies running three months behind with orders, the fight over domestic recorders has stabilised. Neither company wants to get caught as so many did in the colour television boom. The industry plans to proceed cautiously and is happy to have people wait, as long as each company retains its market share.

National has a machine waiting in the wings, we hear, just in case Philips should look like having a success with its eight-hour 2000 video recorder. It is a dual-speed recorder that will offer four hours on standard speed and eight hours at half-speed. Dolby will solve the problem of poor audio at that extra-slow speed. ▶

National-Panasonic's NV-7000 VCR features Dolby audio, remote control and 'cue & review' buttons that permit forward or reverse searching at 9x normal speed.

Will the portable colour video camera take over in the Super 8 movie market?

The only other refinement to come is the use of a variable speed facility so that we can vary the speed of the playback and still have intelligible audio. Rank and JVC now offer a machine with a two-speed audio feature, but a variable control would be a lot better.

Video VS Super 8

This year we will see the fight switch to the portable market, which is expected in the next three years to sign the death warrant of Super 8 home movies.

The Japanese like to sell 50% of their production at home. It makes good economic sense and the overseas markets are then the 'cream'. The odd thing is that Japanese consumers aren't really very interested in video recorders. The reasons usually advanced say they aren't a movie community and anyway they haven't much worth recording on their television. But they are great photographers; they love taking pictures of babies, scenery, and anything that might move, so the video manufacturers are putting all their efforts into producing mini portable video recorders. In the NTSC countries (Japan and USA), Technics and JVC have already reduced the heavy bulky recorders down to about double the size of a VHS tape. A PAL version of these mini portables is due in Australia this year.

Our 'Deep Throat' in the Beta camp tells us that Sony has developed a portable video recorder that is only slightly bigger than the Beta cassette. If this turns out to be true, and not just a ruse to panic the VHS camp, they will have a winner. Matched to their 2000PE camera it seems likely to put paid to any ideas about a re-launch of ¼-inch portable video systems — not that some manufacturers aren't trying!

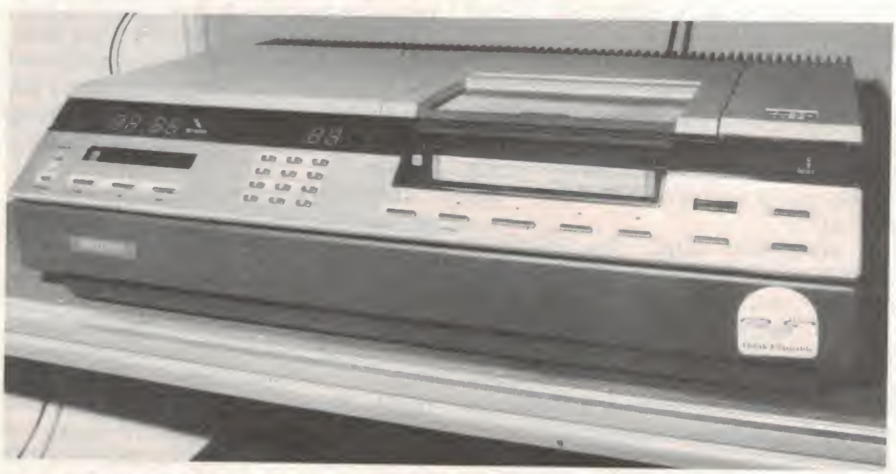
However, the VHS camp has a few tricks up its collective sleeve. JVC showed a unique zoom microphone at the Tokyo Electronics Show last October and National said that it would probably start manufacturing this as an accessory to its camera range. A zoom mic allows you to zoom in on the sound associated with the subject you're filming.

National also plans to incorporate a wireless microphone system in its cameras. The receiver will be built into the camera body and the microphone can be placed close to whatever you are shooting.

It seems a pity National released a camera as sophisticated as the $1600 model WV 3200 without a C-mount lens system. Too many people buying this type of sophisticated camera know about movie making and like to be able to add converters to increase the length of the lens for shooting sport. So this year should see a new National up-market camera with all the bolt-on goodies that the WV 3200 lacks. We should also see cameras trickling on to the market later this year with auto focus. This saves you having to worry about pre-focusing prior to zoomіng to a long-distance shot.

On the other end of the camera scale there will be a campaign to eventually get the price of cameras with optical viewfinders (as distinct from electronic viewfinders, which enable you to play back a scene immediately after shooting it when on location) down to the $500 mark. The disadvantage with an optical viewfinder is that you have to wait until you get home before you can see what the scene is like; if you messed it up you may never have the chance to repeat the shots. Long term, the electronic viewfinder will win out; it's just a bit too expensive for the average Australian yet.

The next three years will see a fierce battle for domination of the portable video market, the aim being to talk buyers into buying component video systems—a portable recorder for home-and-away use, a separate tuner that will stay at home, and of course a good quality camera.



Philips' remarkable eight hour flip-over VCR — probably not a contender here.

Phase three

'Phase three' of the war will introduce the integrated, solid state, portable video system. The betting is that should either the Beta or VHS camp look like losing too much ground over the next few years in the portable fight, we might even see a premature introduction of this new concept that will definitely put the nail in the coffin of any Super 8 market left. Sony, Hitachi, Philips, National Panasonic, JVC, NEC and probably Uncle Tom Cobbley and all have prototypes under wraps in their research and development plants, all anxious to be first in this promisingly lucrative market. Sony and Hitachi have even both given their systems a brief public airing.

The idea is that we do away with the traditional vidicon tube, replacing it with a solid state sensor that takes up very little room. National Panasonic has already developed a solid state camera that is to be used by Japan Air Lines in its jumbos, so that the Japanese, who apparently can't live ▶

Quarter-inch format VCR weighs just 3 kg!

Technicolor Inc, the colour film process pioneer, has entered the video equipment field with the smallest and lightest video cassette recorder yet put on the market.

The miniaturised VCR uses quarter-inch (6.25 mm) colour-and-sound videotape and weighs only 3 kg, including battery.

The unit measures about 250 x 260 x 70 mm and can be used with a standard video colour camera with playback on a TV receiver, obtaining picture and sound fidelity comparable to half-inch tape decks, Technicolor claim. Its 30 or 60 minute cassette weighs 55 grams in its box, compared with current half-inch cassettes weighing more than 330 g. The compact Technicolor cassette easily slips into a shirt pocket or small mailing envelope. It is expected to be widely used as an inter-office "video memo" and for personal "correspondence".

According to Mr. W. Wampfler, Director of Dynasound Pty Ltd, the Technicolor Distributor in Australia, it will be promoted nationwide to the business, education and consumer movie market.

"Our system offers true portability and operating economies unmatched in the industry," Mr. Wampfler said. "For business, the VCR is ideal for demonstration, sales training and documentation. And for the consumer, Technicolor say it is excellent for family gatherings from christenings to weddings, from ballgames to vacation trips and everything in between.

"The Micro Helical System represents an inevitable evolutionary development that has been an industry goal since half-inch tape was introduced. We have cut the size of videotape in half and reduced the cassette size by 75% without loss of picture and sound fidelity. The Technicolor VCR is extremely simple to operate and, compared with others, simple to service."

The Technicolor VCR is the result of a joint effort between Technicolor Audio-Visual and the Funai Electric Trading Co. Ltd, Osaka, Japan. Funai, a manufacturer of electronics equipment for major American companies, initiated the development of the Micro Helical System. Technicolor engineers have been working on the project with Funai for a year and a half.

"Funai will manufacture the VCR, forerunner of other related products in the video field," Mr. Wampfler said. "These will include a Technicolor camera and other innovative items to complement the VCR. They will be offered in the future — not in a matter of years, but months."

Mr. Wampfler predicted that the new quarter-inch videotape format will have a "substantial impact" in the revitalisation of the consumer movie market. Retailing for $12.50, each compact cassette, "will be considerably less expensive and far more flexible than its film equivalent," he said.

"In addition the tape offers the advantages of instant replay and erasure of unwanted scenes, providing reusability not possible with film. It also permits the erasure of sound originally recorded and the substitution of narration, music or sound effects, even by an amateur."

The Technicolor VCR, despite its small size, offers an unusual range of features. Through its ac power adaptor, provided as standard equipment, the VCR operates off normal household current, consuming only eight watts. With its self-contained nickel cadmium battery, it provides 80 minutes of energy when used in playback mode, or 40 minutes for camera recording. The battery recharges in an hour through the adaptor. The VCR also operates off a 12 volt car or boat battery through a cigarette lighter socket. While primarily designed for use with a video camera for business and personal recording, the VCR, with a tuner, may also be used to tape TV programs for later viewing.

The VCR can record to or from another videotape recorder regardless of tape size. Its 240-line picture resolution is comparable to the picture and sound quality of larger VCRs, according to Technicolor engineers. The recorder permits taped scenes to be "frozen" as still images, then advanced at variable speeds through slow motion to a fast-forward speed 1.8 times the normal rate of 32 mm per second. A memory counter automatically stops a rewinding tape at a pre-designated position.

Features include a drop-out compensator to help control possible picture degradation that is occasionally experienced when tapes are reused repeatedly, and a circuit to detect condensation (a possibility with all VCRs). The condensation detection circuit prevents the VCR from operating until any condensation — which could damage a tape's content — is automatically eliminated.

Heart of the VCR is its video head drum assembly, comprising monocrystal ferrite heads with extremely accurate image-tracing capability, according to Mr. Ron Welsh, Technicolor vice president, sales. "This high-precision assembly makes possible the practical use of quarter-inch tape for the first time," he said. "It has an inscribed tape path that insures precise tape alignment on the drum. And it has a rotary transformer that eliminates mechanical wear on the head coupling circuit."

The complete video package, consisting of VCR, power adaptor, battery, carrying strap, switch box connection to a TV receiver, earphone and appropriate connecting cables, cassette and transformers, will have a suggested retail price of $1349.00. Nationwide distribution has been established through video and audio-visual dealers, camera stores and other retail outlets. Further details from Dynasound Pty Ltd, 329 Princes Highway, St Peters NSW 2044. (02)519-5284.

The Technicolor quarter-inch format cassette compared to standard-size cassettes.

The 3 kg VCR is small and light and can be used with any standard video camera.

NEW COLOUR CAMERA COMBINES QUARTER-INCH, TWO-HOUR CASSETTE RECORDER

Hitachi has developed an experimental colour video camera and VCR that they claim has the ease of handling and convenience of an 8 mm cine camera.

Provisionally named the "MAG" camera, the cassette used is little larger than a conventional audio cassette and employs quarter-inch (6.25 mm) wide magnetic tape to provide an amazing two-hour record and playback time. The complete unit weights only 2.6 kg (including the rechargeable battery pack) and is 237 mm wide, 192 mm in height and 76 mm deep (excluding the lens).

This camera uses an f1.8 lens to produce an image on a single-chip MOS colour-image sensor and incorporates a 4x zoom facility. Special high density recording technology has been developed for this miniature camera. Horizontal resolution is 240 lines and the video signal-to-noise ratio is quoted as 45 dB. A helical scan azimuth video recording system is employed.

The audio frequency response in this camera system is given as 30 Hz to 18 kHz with a 50 dB signal-to-noise ratio, a video track frequency modulation composite recording system being used for the audio signal. Audio dubbing is on a special sound track. Power consumption is a mere 7 W!

An ordinary television receiver can be used for playback from this camera; various facilities such as still pictures, slow motion, etc. are under consideration. Hitachi hope this development will lead to a further expansion of the video industry, with standardisation of cassette tapes and of the recording system. Expected release is late 1981 or early 1982.

Brian Dance

PHILIPS AND GRUNDIG SPEAK TOO SOON

An error in the first production runs of Philips' and Grundig's V2000 video cassette system created a sound and picture synchronisation difference of 200 milliseconds when tapes made on a Philips machine were played on a Grundig machine, and vice versa.

The problem is embarrassingly noticeable when the audio leads the video — much more so than when the audio lags the video, according to recent research into human perception at the Department of Psychology of University College London, UK.

The production error resulted in the machines being made with the sound heads in different positions in the two companies' machines. Although both companies have now re-tooled to adopt a compromise position which gives full compatibility, this has created a 100 millisecond incompatibility between their own past and present models. The University College research explains why this is more noticeable in some cases than in others.

People are more irritated by out-of-sync sound and pictures when the sound arrives ahead of the action than when it arrives behind, according to Norman Dixon and Lydia Spitz. Their research, carried out in the mid-1970s, made use of a video recorder that had been modified so that its audio head could be moved to advance or delay the sound in relation to its corresponding picture by up to 500 ms. Twenty-eight English and Spanish subjects watched video tape recordings of a man reading prose and a hammer hitting a peg. Each subject was asked to advance and retard the sound with a remote control key, and release the key as soon as they detected asynchrony.

On average, auditory *delays* of up to 258 milliseconds on speech and up to 188 milliseconds on the hammer strike passed unnoticed. But an *advance* of only 131 milliseconds on speech and 75 milliseconds on the hammer was immediately noticed.

The researchers suggest two possible explanations for this discrepancy. Either the human brain has evolved to detect the unlikely occurrence of sound preceding vision, or we have learned to expect sound to follow vision and even use the lag as a cue in distance detection. This would explain why the audience in a large theatre, cinema or concert hall is not disturbed by the delay in sound arriving from a distant actor or performer.

without their television (even at an altitude of 15 km), can climb on board jumbos and watch local baseball matches and TV commercials prior to take-off. Even worse for the nervous, during take-off the runway is shown on giant projection screens via a camera mounted in the cockpit!

The new solid state camera is about half the size and weight of a standard 16 mm cine camera. The next step is to develop a camera that has a solid state sensing system with a mini recorder all built into the camera body. Sony has a prototype that I saw in Tokyo last October which uses a micro-size cassette giving between 15 and 20 minutes of recording. Hitachi has another prototype that uses a compact cassette and offers about one hour's recording.

National's WV3300E features their high resolution 'Cosvicon' tube, a standard 6:1 zoom lens and electronic viewfinder.

NEC has followed a different path. It is developing a solid state camera that has a two-to-four hour memory. It stores the picture and sound in a solid state memory until you get home, then you transfer it on to conventional video tape.

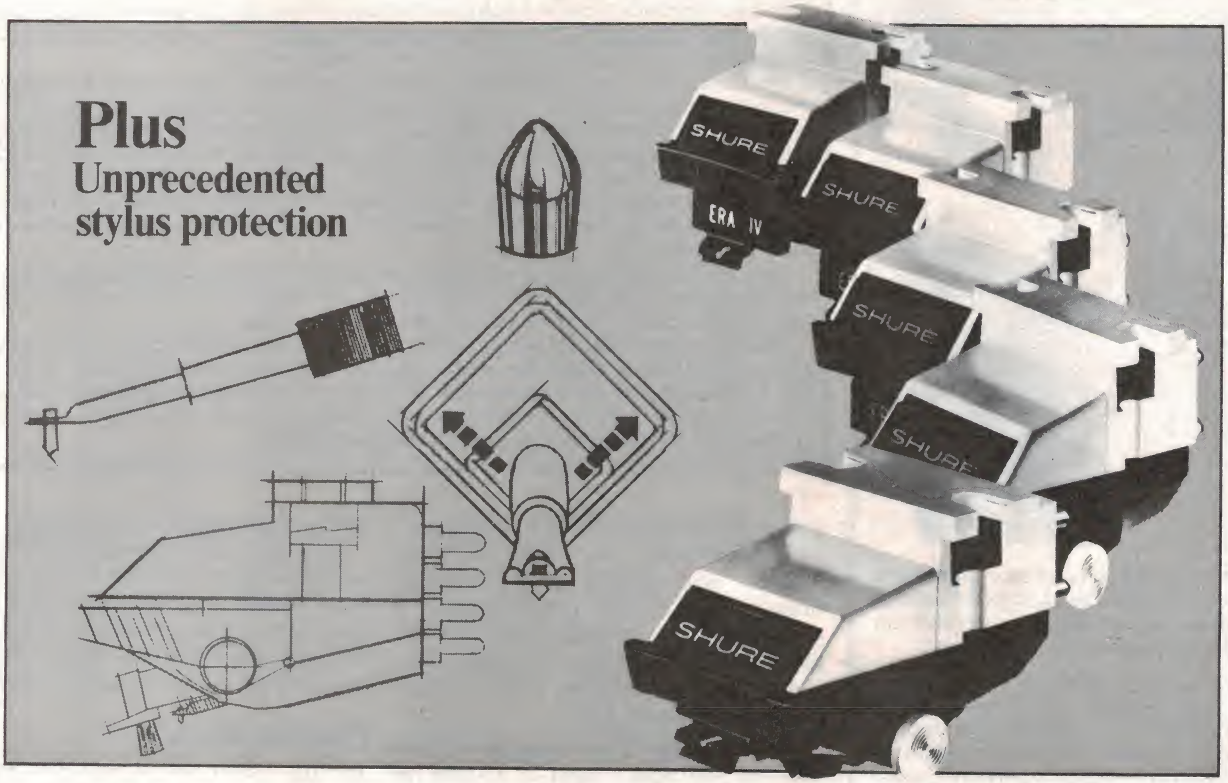
Further ahead

In five years we should realistically expect to see mini video cameras that we will be able to take on holidays and shoot the family having fun without needing a semi-trailer to carry the gear around. The only thing that will mar these exciting developments is the inevitable format war. The different manufacturers will all want their system to be the accepted standard because of the cash the licensing will bring flooding in.

Our irritation at this cut-throat commercialism might be tempered by the fact that a system war is likely to be the friend of the consumer. Working on the American system of "let the market decide", the various manufacturers will offer features and prices that may send them broke in the end but will give us, the consumers, real value for money in the short term. By then we will all be into PCM video and the whole analogue hardware and software will be archaic junk.

Whoever wins the battle, the next ten years of the video market look like being the most exciting since cinema audiences first heard Al Jolson sing 'Mammy'.

fact: five new Shure Cartridges feature the technological breakthroughs of the V15 Type IV



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Marantz Tt 1000 turntable — brilliant, beautiful, esoteric . . .

Louis Challis could find practically nothing wrong with the Marantz Tt 1000 turntable from their Esotec range — except that he couldn't afford to buy it. This is top-of-the-line equipment for people who rate hi-fi as their greatest pleasure in life.

Louis Challis

MARANTZ PRODUCE a number of esoteric pieces of equipment and have in fact included them in a range called ESOTEC. The most esoteric of this range is undoubtedly the Tt 1000 Direct Drive Record Player System.

Glass and brass

The major difference between this turntable and any other turntable you may have seen is the unstinting use of glass for both the turntable base itself and, in lieu of the conventional rubber mat, on top of the turntable platter. In England there is currently a small but aggressive firm which is marketing glass tops to replace the rubber mats on record players and they cannot keep up with the demand. Not only does glass improve the mass and inertia of the turntable, but they claim it has a better surface for the records to rest on than the conventional rubber mats. Some people appear to have come to think that glass is the greatest thing since sliced bread and can be used almost anywhere; Marantz' design approach has been to produce something so esoteric and expensive that one starts to seriously question the rhymes and reasons of Marantz' marketing personnel.

There can be no denying that the appearance of the Tt 1000 is striking. It has a base constructed of two layers of 15 mm glass and a central 8 mm thick anodised aluminium core. This unusual

combination has been selected to achieve the maximum mass with the highest possible level of damping. The base is supported at the four corners by large pneumatic aluminium and rubber mounts.

The turntable is a massive aluminium disc surmounted by a 5 mm thick glass turntable mat, giving a combined weight of 3.4 kg. The only controls provided are two electronic sensor buttons for selecting the two fixed speeds of 33⅓ or 45 rpm and a similar start/stop button, all of which are located approximately 30 mm from the front edge of the plinth.

The colour combination is greeny glass and golden-hued aluminium (which looks like polished brass), but of course there is more to this unit than just glass and brass! ▶

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RUMBLE

-64dB weighted
-44dB unweighted

SENSITIVITY

Right Channel	1.07mV/cm/sec
Left Channel	1.03mV/cm/sec

FREQUENCY RESPONSES 20Hz-20kHz

CROSSTALK

	100Hz	1kH	6.3kHz
Left into Right	-32dB	-32dB	-21dB
Right into Left	-20dB	-21dB	-26dB

TONE ARM RESONANCE

9.5Hz (see attached graph)

TOTAL HARMONIC DISTORTION

(2.24 cm/sec @ kHz)

	100Hz	1kHz	6.3kHz
Left	2%	1.2%	2.7%
Right	1.5%	1.6%	2.9%

TRACKABILITY

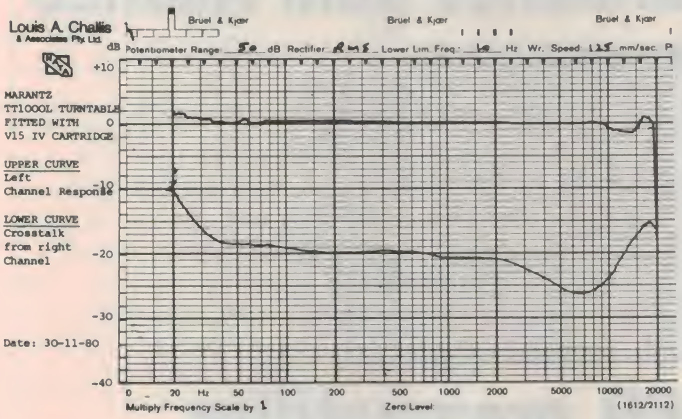
(Using Shure Disc TTR 103 400 and 4000Hz)

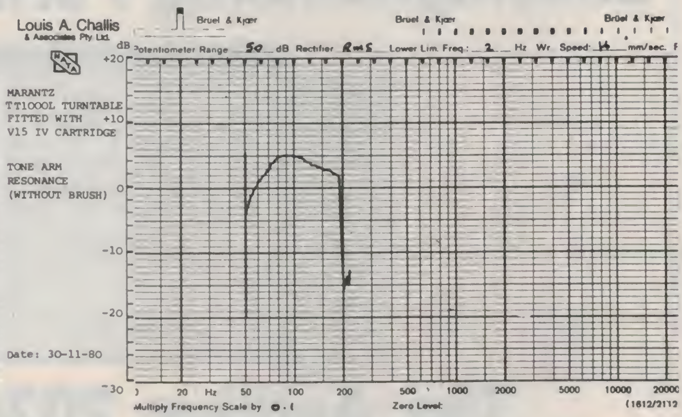
Tracks all levels at 1.0 gramms. Photo shows distortion components (including those of disc at two highest levels 24 and 30 cm/sec peak velocity)

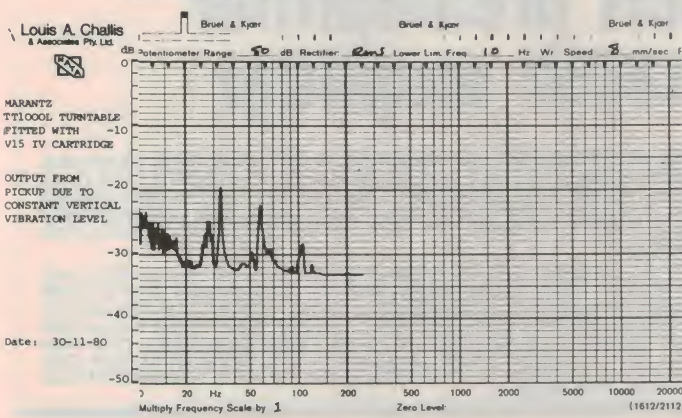
SENSITIVITY TO EXTERNAL VIBRATION

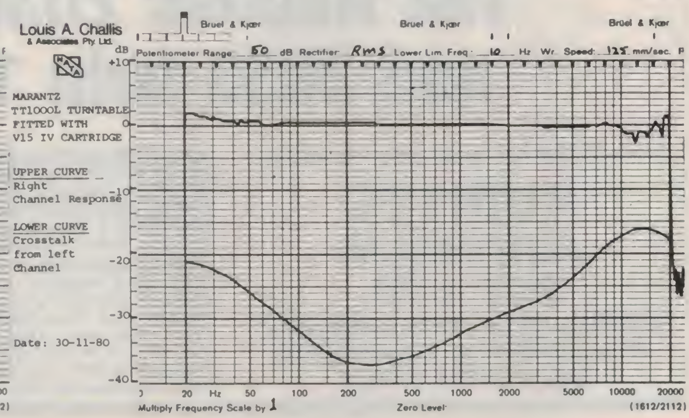
Main resonances at:-

28, 33, 56, and 110Hz









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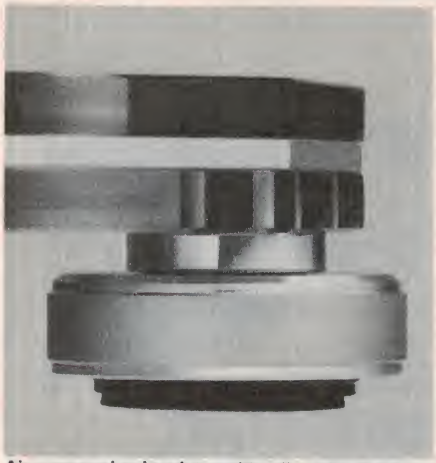
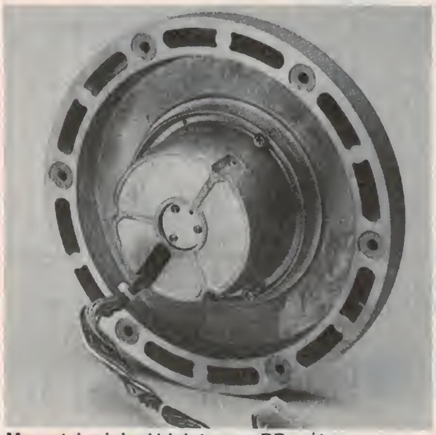
SOUND review



Air suspension insulator with adjustable height.



Marantz' original high torque DD motor.

Technical features

The motor drive incorporates a superbly made quartz-locked, eight-pole, twelve-slot, brushless motor with a massive 1.6 kg starting torque. This really is needed to accelerate the heavy turntable, which has a moment of inertia of over 700 kg/cm^2. The motor develops sufficient torque to allow the unit to reach the selected speed within half a turn.

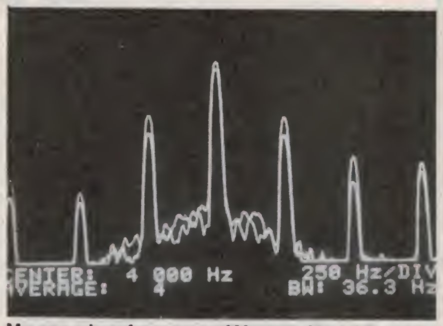
The control and feedback quartz-controlled phase-locked circuitry is very neatly mounted under a metal cover beneath the turntable. In order to keep the appearance of the turntable plinth as simple as possible, the motor's power supply is incorporated in an external lacquered module with dimensions of 310 mm long by 90 mm wide by 80 mm high, which is connected by a simple two-core flex to the turntable.

To cater to the tastes of the purists who would be likely to purchase the turntable, the unit does not normally come equipped with its own tone arm. For testing, however, the agents provided this unit with the latest SME Series 3 arm and Shure V15 Type IV cartridge. The universal adaptor plate and aperture are capable of accepting a wide range of alternative tone arms (optional adaptor plates are available), and the plinth can simultaneously accept a second tone arm, which would be mounted in a hole at the rear of the turntable platter (on the left hand side in a hole which normally accommodates a 45 rpm adaptor ring).

On test

The objective testing of this unit was as much a test of the SME tone arm and Shure V15 Series IV cartridge as it was of the turntable. The wow and flutter were impeccable, with a wow of only 0.1% peak to peak and a flutter of 0.02% weighted rms and 0.05% unweighted rms. Obviously the high mass does work, solving virtually any problems before they can be created. The rumble was less than −64 dB weighted and −44 dB unweighted, which are currently about the best figures that we have seen from any turntable. The vibration resonance characteristics of the turntable and isolators are particularly low, manifesting themselves as only three significant but low-level resonances in the frequency range 20 Hz to 120 Hz. In my opinion the resonance characteristics of the Tt 1000 are the lowest we have yet seen from any turntable, irrespective of its selling price.

The characteristics of the tone arm and cartridge are equally impressive. The frequency response of the cartridge is particularly smooth, essentially within 2 dB from 20 Hz to 20 kHz. The channel separation, whilst generally good, is particularly good at the high frequency end. The trackability of the cartridge on the Shure TTR 103 test record is exceptionally good, and it is able to track all levels of the test signals at 1 g tracking weight, without measurable or audible signs of mistracking. In evaluating the cartridge on other 'torture tests' it responded as well as any cartridge we have tested to date. The tone arm resonance is also the smoothest I have seen to date, as well as falling in the preferred 8-11 Hz region, which is now regarded as the optimum frequency range to minimise interaction between recorded content and the output from warped or distorted records.



Measured performance of Marantz Model Tt 1000L turntable.

Subjectively

If we were happy with the objective tests we were more than happy with the subjective testing. The combination of the Esotec Tt 1000 turntable, the SME Series 3 arm and V 15 Series IV cartridge provides what must amount to one of the best possible combinations that money can buy (with emphasis on the money!).

Playing a series of direct-recorded discs, warped discs, discs with nasty low frequency content and discs requiring unusual trackability performance, showed clearly that this system borders on the superlative in areas where even most good turntables only provide good to above average performance.

Before you decide to race down to your local shop to place your order it might be appropriate to dampen your ardour and tactfully mention that the Tt 1000 has a recommended retail price of $2499, without the tone arm and cartridge. As you will undoubtedly spend more than $500 on your tone arm and cartridge, this is obviously a system that few can afford but for which many may rightly aspire.

(Editor, maybe we should make this Australia's gift to Charles and Di?) ●

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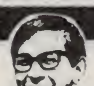

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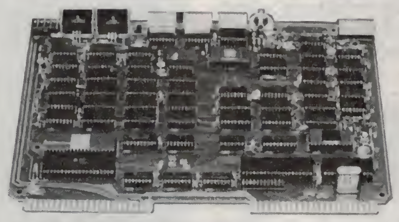

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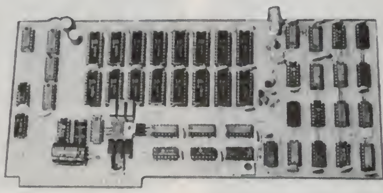

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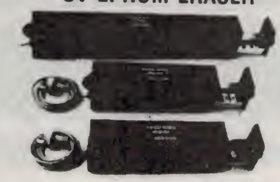

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NOTES AND ERRATA

Improvements to the RTTY system. (March p.54.) On Figure 7 (p.57), transistors Q1 to Q8 are small signal types such as BC107, BC547, BC108, BC548, 2N3564 etc. The UART may be an MM5303N or equivalent, while IC1, IC2, IC4 and IC5 are all type 4001 and IC3 is a type 4000. On page 56, Q1 and Q2 on the tuning CRO diagram should be shown as types BF338, 40327, 2N3440 or similar device with 300 V Vce rating.

pH — the acid test. (Dec. p.16.) As ETI staff are generally more electronic enthusiasts than amateur horticulturists, gardeners etc, we boobed in this article. Firstly, on page 19, following 'Neutrality and activity', the third sentence reads . . . "In pure water at room temperature only about one water molecule in ten million dissociates into ions." This should read ". . . about one water molecule in 600 million . . ." Later, the section on 'Soils' (page 21) became entirely mixed up! K.A. Handreck, from the CSIRO Division of Soils in South Australia, advises that camelias and azaleas thrive at pH 4 - 5, while they're sure to die at pH 8 - 9, or even 6 - 7. R.J. Talbot of the Queensland Agricultural College's Department of Biology says the camelias and azaleas thrive at pH 5 - 6 and would die quickly at pH 8 - 9. He also says the vast majority of plants flourish at pH 6 - 7 and few will make normal growth at pH 9 and that, while potatoes and tomatoes will do reasonably well at pH 5 - 6, they'll produce more at pH 6 - 7. Mr Handreck also pointed out that bone meal will increase soil pH and phosphates do little for it. Mr Talbot says an efficient pH reducer is sulphate of ammonia, or for very acid soils, alum. So far as we know, the rest of the article is OK.

The CSIRO has available a small booklet that may be of interest, called "What's Wrong With My Soil?" (Cost $1.50). This is number five in a series of eight in the CSIRO's 'Discovering Soils' booklets. They are available from Australian Government Publishing Service Bookshops in every state capital, or from the CSIRO Editorial and Publications Service, P.O. Box 89, East Melbourne 3002 (post free in Australia).

ETI-152 linear scale capacitance meter. (Feb. p.57.) The instrument will not function properly on the 1u/x10 scale (i.e: 10u full scale) as the integration time is not long enough. A simple modification cures this. Change SW3 to a DPST type. Change R1 to 1M2. Add a 100 ohm resistor switched across R7 by the extra pole of SW3. See Dec. page 80 for modified circuit.

ETI-247 soil moisture indicator. (Nov. p.51.) There is an error in How It Works on page 52. The circuit on Figure 3, lower right, shows the zener the wrong way round.

ETI-250 simple house alarm. (Aug. p.42.) This was incorrectly numbered ETI-262. The pc boards available are correctly numbered ETI-250.

ETI-255 electronic temperature meter. (Nov. p.38.) The meter in the circuit diagram on page 39 was shown the wrong way round. The negative terminal of M1 goes to pin 2 of the LM3911.

ETI-455 speaker protector. (March p.39.) On page 41 there is a note on the circuit diagram that says "D1-D4 are 1N914; D5, D6 are 1N4004". This is incorrect; the parts list shows the correct types.

ETI-456 140W valve amplifier. (May p.29.) On page 31, at the bottom of the power supply circuit, the note should read: "The **power** transformer . . .". In the parts list on page 35, D1-D10 and D11-D15 are listed incorrectly. D1-D10 are A14Ps and D11-D15 are 1N4004s as shown on the circuit diagram. ▶

Notes and errata continued from page 155.

ETI-467 four-input preamp for the 466. (July p.47.) Firstly, on the circuit (page 49) exchange R34 and R35. The 1k resistor R34 should now be connected from pin 9 of IC2b to the common rail (earth, or 0 V). The capacitor across the presence control, a 4n7 marked 'C20', is actually C24. These three components are correctly marked on the overlay.

Next, on the overlay photo (page 50) IC1 and IC2 have been shown with the incorrect orientation. Pin 1 of IC1 is located diagonally opposite to where it is shown on the overlay. It should be adjacent to R1. Similarly with IC2, pin 1 should be located adjacent to R23. The pc board copper side has them marked correctly.

On the Parts List, R35 and C24 do not appear. Add a 270R resistor and a 4n7 greencap, respectively. Finally, in the second paragraph on page 50, the maximum output is quoted as "... 200 volts peak to peak ...". In reality, it is a more modest 20 volts peak to peak. Kit and component suppliers have already been notified.

ETI-475 quality AM tuner. (Sept. p.19.) RFC1 was omitted from the parts list. This is a Philips type VK200 wideband choke and consists of a six-hole ferrite bead (type number 4312-020-31550) with a length of 22 swg tinned copper wire passed through it five times. In the antenna details the copy beneath the antenna matching coil on page 26 should read: "For use with small loops 6-8 turns" and "For use with large loops 2 turns".

ETI-476 Series 3000 compact stereo amp. (Nov. p.26, Dec. p.32.) An error appears in the How It Works on page 28. Under the sub-heading "Power Amplifier" third paragraph, there is a sentence which reads: "This leaves a total of 0.6V to be dropped across the two 27 ohm resistors R27 and R28". It should read "... 100 ohm resistors R27 and R28".

On the overlay (in both Nov. & Dec.) R34 is shown as 270R when it should be 180R. In the parts list, R25, 26, 125 **and** 126 should be shown as 180R. Only R34 should be shown as "180R, see text". Capacitor C21 (same as C20) was left off the parts list.

ETI-561 metal detector. (March p.30.) The component overlay on page 33 shows R3 as a 1M resistor where it should be 100k.

ETI-564 digital clock. (August p.27.) The pc artwork on page 137 is missing a track between pin 5 of IC2 and pin 11 of IC3. With this missing, the project will work but the clock will gain around four minutes a day as IC2 will divide by a little less than 3000.

ETI-566 pipe and cable locator. (April p.36.) Constructors are referred to the October issue, Lab Notes, p.51.

ETI-578 simple nicad charger. (June p.59) R2 should be shown as a 1W resistor.

ETI-681 programmable character generator. (June p.67.) In Table 1 on page 69, the heading at the top of the left hand column should read "Value of Rp" as the values of RV1 and RV2 are fixed at 5k. On page 70, IC27 has a pin at the bottom marked "18" when it should be 15 — it's only a 16-pin chip, anyway! On page 73, in the parts list, R3 is listed as 1k9, 2%. A 1k8, 5% resistor is OK here. On page 74, under "Dipswitch No. 2:", second paragraph, the lines "We recommend that you put the joystick port at hex 'FF' ..." should say "... put the joystick port at hex 'EF' ...". The joystick setup procedure is correct as it places the joysticks at EF.

In addition, a number of typographical errors appeared on the circuit diagram on page 70. Address lines A11, A13 and A14 were shown as going to pins 27, 35 and 36 respectively. This is incorrect. A11 goes to pin 87, A13 to pin 85 and A14 to pin 86.

ETI-726 70W 6/10m booster amp. (Feb. p.65.) The overlay was perhaps not as clear as it could have been in a few places. The coax cables, A and B, shown near the changeover relay, seem to have their shields connected to the RF output track beneath them. Actually, the lead going up to the comment 'shields earthed' indicates what to do with them. Strap them to the ground to the left of the relay, adjacent to the shim strap.

As the low frequency gain of the DX542CF, used in the ETI-726, is uncharacterised some amps may show HF instability. This problem is easily cured by damping RFC1 with a resistor, around 5 ohms in value, connected in parallel.

If you like to play it safe with regard to TV1, the filter described for use with ETI-715 6m amp, published on p.52 of the January 1978 issue of ETI, will serve very well.

ETI-1500 discriminating metal detector. (Dec. p.39.) There are a number of designation errors on the circuit on page 42. Firstly, terminals T and V, which go to the volume pot RV5, are shown the wrong way round on both the circuit and wiring diagram. Transpose them and the pot will work in the correct manner. Secondly, the pin numbers to IC2a are shown incorrectly. The gate is actually pin 6 (not pin 3). The drain and substrate are connected (internally) to pin 14 which goes to +10 V. The source is pin 13 (not pin 1). Pins 1 and 2 of IC2a are unused. Pin 3 goes to 0 V. The overlay is correct.

It appears that C20 is shown on the overlay with incorrect polarity. The capacitor's construction and location of the + sign make this a bit confusing. The negative side connects to terminal R. Resistor R33 is shown as 10k on the circuit diagram. It should be 100k. The overlay and parts list are correct.

Search head wiring should be as follows: receive coils, red and black (resistance, about 50 ohms). These go to pins j and k on the pc board, via the DIN plug and socket. The cable shield and white wire are connected to the transmit coil (resistance about 12 ohms). The shield goes to 0 V at pin i and the white wire to pin h. Any extra wires in the head cable are unused.

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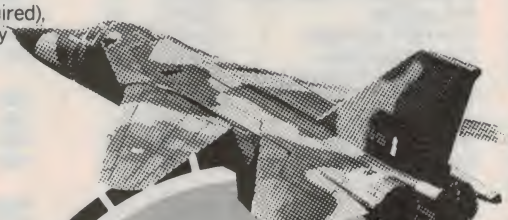

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102	Audio Signal Generator	June 71	56	25TP, AP, TG1
103	Logic Probe	July 71	46	25TP
104	Soldering Iron Control	Aug 71	120	
105	Dual Power Supply	Nov 71	72	25TP, TP2, TG1
106	Scope Calibrator	Feb 72	41	25TP, TG1
107	Wide-range Voltmeter	Feb 72	50	25TP
108	Decade Resistance Box	Sept 72	46	25TP, TG1
109	Digital Frequency Meter	Sept 72	62	25TP
110	FET Voltmeter	Oct 72	68	SP1
111	IC Power Supply	Nov 72	48	25TP, TG1
112	Audio Attenuator	Mar 73	43	TP2, AP, TG1, 30AP, TG2
113	7-input Thermocouple Meter	Sept 73	95	
114	Dual Beam Adaptor	July 74	64	TP3, TG1
115	Integrated Circuit Tester	Aug 74	72	TP3, TG1
116	Impedance Meter	Mar 75	55	TP3, TG1
117	Digital Voltmeter	Aug 75	29	TP3, TG1
118	Simple Frequency Counter (meter)	Sept 75	71	TP3, TG1
119	Five-volt Switching Regulator Supply	Dec 75	71	TP3, TG1
120	Logic Probe	Sept 75	46	TP3, TG1
121	Logic Pulser	Sept 75	49	TP3, TG1
122	Logic Tester	Oct 75	71	TG1
123	CMOS Tester	Nov 75	57	TG1
124	Tone Burst Generator	Nov 75	49	TP3, TG1, 30AP
124AB	Silent A/B Switch	Dec 75	48	TG1
125	Grid Dip Oscillator	June 75	38	
126	RF Level Control	Jan 75	96	
127	TTL Supertest	Feb 75	53	
128	Audio Millivoltmeter	Jan 76	73	TG1, 30AP
129	RF Signal Generator	Jan 76	55	TG1, 30AP
130	Temperature Meter	Feb 76	43	TP4, TG1
131	General Purpose Power Supply	Apr 76	74	TP4, SP2, TP7
132	Experimenter's Power Supply	Feb 77	45	TG1, TG2
133	Phase Meter	Apr 77	45	TG1
134	True RMS Voltmeter	Aug 77	70	TP5, TG2
135	Digital Panel Meter	Oct 77	75	TP5, TG2
136	Linear Scale Capacitance Meter	Mar 78	11	TG2
137	Audio Oscillator	May 78	35	TG2
138	Audio Power Meter	Nov 78	78	TG2
139	SWR/Power Meter	May 78	75	TG2
140	1 GHz Frequency Meter-Timer	Mar 78	85	TG2
140	Part 2	Apr 78	77	TG2
141	Logic Trigger	Jan 79	37	TG2
142	High Current Power Supply (dc)	Feb 79	42	TG2, TP7
143	Curve Tracer	Jan 79	43	
144	Expanded Scale RMS Voltmeter	June 79	65	TG2
146	The Mainsmaster	Nov 79	45	
147	Electronic Dummy Load	Oct 80	30	
148	Versatile Logic Test Probe	July 79	71	TG2
149	Two-tone Generator for Testing Single Sideband Systems	July 80	41	
150	Simple Analogue Frequency Meter	Dec 79	43	TP6
151	Linear Scale Ohmmeter	Jan 80	59	TP6
152	Linear Scale Capacitance Meter	Feb 80	57	TP6

SIMPLE PROJECTS

No.	Project	Issue	Page	*Also In
201	Current Limiter	Apr 71	41	
202	Balance Meter for Stereo	May 71	71	
203	Moisture Alarm	June 71	44	
204	Elapsed Time Indicator	Aug 71	54	
205	Doorbell	Sept 71	78	
206	Metronome	Oct 71	86	
207	Emergency Light	Oct 71	88	
208	Loud-hailer	Nov 71	81	SP1
209	Meter Mount	Oct 72	50	25TP
210	Electronic Decision Maker	Jan 73	30	
211	Audio Frequency Meter	May 73	54	
212	Earth Resistance Meter	May 73	43	
213	The Revealer (metal detector)	June 73	55	TP2
215	Cyclone Detector	Nov 73	143	
216	TV Ghost Eliminator	Feb 74	90	SP1
217	12 Volt Power Supply	Feb 74	104	
218	Monophonic Organ	May 74	58	SP1
219	Hee-haw Siren	May 74	60	SP1
220	Wailing Siren	May 74	60	SP1
221	Basic Power Supply	May 74	61	SP1, TG1
222	Transistor Tester	May 74	62	SP1, TG1, SP2, TG2
223	Multivibrator	May 74	63	
224	Temperature Alarm	May 74	64	
225	Simple Amplifier	May 74	65	SP1
226	Temperature Meter	May 74	71	
227	Crystal Radio	May 74	72	SP1
228	Pocket Metronome	Aug 74	76	
229	Meter Beater	Nov 74	60	
230	The Family Ferry	Sept 74	77	
231	Flip-flop Flasher	Jan 75	63	
232	Courtesy Light Extender	Oct 74	67	SP1, SP2
233	Electronic Combination Lock	Oct 74	59	
234	Simple Intercom	Oct 74	70	SP1, SP2
235	Bicycle Speedometer	Mar 75	47	
236	Code Practice Oscillator	Aug 75	44	SP1, SP2
237	Simple Loudness Control	May 75	67	
238	Headphone Adaptor	Dec 75	45	
239	Breakdown Beacon	May 76	77	SP2
240	Emergency Flasher	May 76	47	SP2
241	Double Dice	July 76	56	
242	Neo Nim	Aug 76	63	
243	Bip Beacon	Apr 77	65	
244	Alarm Alarm	Feb 77	58	
245	White Line Follower	Nov 77	50	TP5
246	Rain Alarm	Apr 78	69	
247	Soil Moisture Indicator	Nov 80	51	
248	Simple 12 V to 22 V Converter	July 78	94	
249	Electronic Combination Lock	Apr 79	34	
250	Simple House Alarm	Aug 80	42	TP7
252	The 'Passionmeter'	Aug 79	60	
253	'Hot Potato' Game/Electronic Grenade	May 79	63	
254	Novel Egg Timer	June 79	73	
255	Electronic Thermometer	Nov 80	38	TP7
260	Lamp Flasher	Dec 79	58	
261	Electronic Foghorn	Dec 79	60	
262	Simple Intercom	Dec 79	62	TP6
263	Simple Eggtimer	Dec 79	56	
264	Simple Siren	Mar 80	50	
266) 267)	Two crystal sets	Dec 79	52	PE (4 ed)
270	Solar-powered Reflex Receiver	Dec 79	48	

CAR EQUIPMENT

No.	Project	Issue	Page	*Also In
301	Variwiper	May 71	34	25TP
302	Tacho-dwell Meter	July 31	51	
303	Brake-light Warning	Oct 71	72	TP2
304	Headlight Dipper	Nov 71	68	SP1
305	Alarm	Jan 72	49	25TP
307	Headlight Warning	Oct 72	71	
307	Headlight Reminder	Oct 74	64	
308	Blinker Extinguisher	Feb 73	70	
309	Battery Charger	Aug 73	76	TP2
310	Ignition Timing Light	June 74	58	
311	Tacho Timing Light MkII	Sept 74	52	
312	CDI Ignition System	Dec 74	86	
	" " "	Jan 75	53	
313	Car Alarm	Nov 74	56	SP1, TP3, SP2
314	Auto Amp	Feb 75	50	SP1, SP2, 30AP
315	Solid State Flasher For Cars	Feb 75	59	
316	Transistor Assisted Ignition	May 77	51	TP5, TP6
317	Rev Monitor/Counter	July 77	43	SP2
318	Digital Car Tacho	July 78	50	
319	Variwiper MkII	Sept 78	40	
320	Battery Condition Indicator	Apr 79	44	TG2, TP7
321	Fuel Level Alarm	Jan 80	53	

* See page 161 for key to project book codes.

April 1971 — March 1981

				Also In
322	Over-rev Alarm	Mar 80	45	
324	LED Tachometer	Aug 80	35	TP7
325	Auto Probe Tests Vehicle Electricals	May 80	39	TP7
326	Expanded Scale LED Voltmeter	Sept 80	36	TP7
327	Turn and Hazard Flasher	Oct 80	40	
328	LED Oil Temperature Meter	Jan 81	39	
329	Expanded Scale Vehicle Ammeter	Feb 81	19	

AUDIO/RADIO

400	Speaker System	June 75	60	TP3, 30AP
401	FET Four-input Audio Mixer	Sept 71	52	25TP, AP
402	Concert Hall Four-channel Sound	Apr 71	24	25TP, SP1, AP
403	Guitar Sound Unit	Apr 71	54	
404	FM Conversion	Apr 71	83	
405	Speaker Enclosure (Magnavox 8.30)	Aug 71	32	
405R	Revised Magnavox	July 72	51	25TP
405S	Mini-Magnavox	Aug 72	60	
406	One Transistor Receiver	Dec 71	60	25TP, SP1, SP2
407	Bass Amp (bass booster)	Dec 71	64	
408	Spring Reverb Unit	Mar 72	60	25TP
409	Hi-Fi TV Sound	Mar 72	38	25TP
410	Super Stereo	May 72	50	
413	100 Watt Guitar Amp	Dec 72	78	TP2, AP
413x2	200 Watt Bridge Amp	Sept 75	26	
414	Master Mixer	Feb 73	50	AP, 30AP
	" "	Mar 73	58	
	" "	Apr 73	78	
	" "	May 73	59	
414	Stage Mixer	Mar 75	68	
	" "	Apr 75	68	
414a	Master Mixer Modification	Aug 73	104	
415	Philips Quadraflect	Jan 73	36	
416	25 Watt Amplifier	June 73	77	TP2
	" " "	July 73	76	TP2
417	Amp Overload Indicator (overled)	Aug 73	84	TP2, AP
419	Guitar Preamp	Sept 73	68	TP2, AP
420	Four-channel Amplifier	Jan 74	64	TP2, AP
420G	Replacement Model	Dec 75	80	
420E	SQ Decoder	Mar 74	71	TP2, AP
422	International Stereo Amp	May 74	73	AP
	" " "	June 74	74	AP
422B	Booster Amp	Oct 75	52	TP3
422	50 Watt Power Module	Oct 75	56	TP3
423	Plus 2 Add-on Decoder Amp (four-channel SQ adaptation)	Apr 74	74	AP
424	Spring Reverberation Unit	Sept 74	58	AP, SP1
425	Integrated Audio System	June 72	66	
	" " "	July 72	62	
	" " "	Aug 72	42	
	" " "	Sept 72	70	
	Revision to int. audio system	Dec 72	63	
426	Rumble Filter	Oct 74	56	AP, 30AP
427	Graphic Equaliser (see 485)	Oct 74	73	AP
428	Colour Organ	Nov 74	77	TP3
429	Simple Stereo Amplifier	Dec 74	38	SP1
430	Microphone Line Amplifier	Mar 75	66	30AP
431	FM Antenna	Apr 75	79	SP1, SP2
432	Ceramic Cartridge Preamp	June 75	67	
433A 433B	Active Crossover	Sept 75	39	TP3, 30AP
434	Tape Control Unit	Oct 75	46	
435	Crossover Amp	Oct 75	63	TP3
436	Dynamic Noise Filter	Sept 75	16	TP4
437	Simple Speaker	Nov 75	72	SP1
438	Audio Level Meter	Dec 75	51	TG1, 30AP
439	Three-way Speaker System	Dec 75	57	30AP
440	Simple 25 Watt Amp	July 75	66	TP3, 30AP
441	Audio Noise Generator	Jan 76	40	TG2, TP3, TG1 30AP
443	Audio Compressor/Expander	Apr 76	49	TP4
444	Five Watt Stereo	June 76	44	
444	Five Watt Stereo Amp Modification	May 77	66	
445	General Purpose Preamp	July 76	72	30AP
446	Audio Limiter	Aug 76	57	TP4, 30AP
447	Audio Phaser	Sept 76	51	TP4
448	Disco Mixer	Nov 76	60	
449	Balanced Microphone Amp	Nov 76	56	30AP
450	Bucket Brigade Audio Delay Line	Dec 77	40	TP5, 30AP
451	Hum Filter for Hi-Fi Systems	July 79	76	TP6
452	Guitar Practice Amp	Jan 80	47	TP6
453	General Purpose Amp	Apr 80	51	
454	Fuzz/Sustain Unit	Apr 80	44	TP6
455	Speaker Protector	Mar 80	39	TP6
456	140W Valve Amplifier	May 80	29	TP7
457	Scratch and Rumble Filter	Sept 80	47	TP7
466	300W Power Amp	Feb 80	44	TP6
467	Four-input Guitar/Mic Preamp to Suit the ETI 466 Module	July 80	47	
470	60W Audio Amplifier Module	May 79	45	TP6
471	High Performance Stereo Preamp Control Unit	June 79	56	TP6
472	Series 4000 Stereo Amplifier	July 79	60	TP6
473	Series 4000 Moving Coil Cartridge Preamp	Oct 79	40	TP6
474	High-to-low Impedance 'Interface' to Suit the ETI 470 60W Amp	Jan 80	64	TP6
475	Quality AM Tuner	Sept 80	19	TP7
476	Series 3000 Compact Stereo Amp	Nov 80	26	TP7
477	MOSFET Power Amp	Jan 81	20	
	" " "	Feb 81	26	
	" " "	Mar 81	30	
480	50-100 W Amp Modules	Dec 76	64	TP4, 30AP
481	12 V 100 W Audio Amp	May 77	58	30AP
481	High Power PA/guitar Amp	June 77	61	30AP
482	Stereo Amp	Jan 77	56	TP4
482	Stereo Amp Part 2	Feb 77	53	TP4
483	Sound Level Meter	Feb 78	28	TG2
484	Simple Compressor Expander	July 77	32	TP5, 30AP
485	Graphic Equaliser	June 77	28	TP5, 30AP
486	Howl-round Stabiliser	Nov 77	56	TP5, 30AP
487	Audio Spectrum Analyser	Feb 78	12	TG2, TP5, 30AP
489	Audio Spectrum Analyser 2	Apr 78	62	30AP, TG2
- - -	Simple Loudness Control	May 75	67	SP2
490	Audio Compressor	Dec 78	81	
491	Graphic Equaliser	Mar 79	68	
495	Transmission Line Speakers	Aug 77	11	TP5, 30AP
496	Series 4000 Four-Way Loudspeaker	Feb 80	74	TP6, TP7
497	Series 4000 Three-Way Loudspeaker	June 80	51	

GENERAL

500	Utiliboard	Aug 75	41	SP1, TP3
501	Green Grass Electronically	Apr 71	34	
502	Emergency Flasher	May 71	51	
503	Burglar Alarm	May 71	56	25TP
503	" "	June 71	36	25TP
504	Reaction Timer	July 71	59	
505	Strobe	Aug 71	74	25TP, TP2, SP1
506	Infra-red Alarm	Sept 71	56	25TP
507	Farmers' Problem	Sept 71	84	
508	Dimmer (fluorescent light)	Oct 71	50	
509	50-day Timer	Dec 71	46	
510	Safety Crossing	Jan 72	34	
511	12 Volt Battery Eliminator	Feb 72	68	TP2, PE
511B	240 Vac/9 V Eliminator	Feb 72	68	TP2
512	Photographic Timer	Mar 72	44	25TP
513	Tape Slide Synchroniser	Apr 72	46	TP2
514	Flash Unit — Sound Operated	May 72	38	25TP
514B	Versatile Flash Trigger	May 76	71	
515	Flash Units — Light Operated	May 72	42	25TP
516	Fluorescent Light, 12 Volt Inverter	Nov 72	78	TP2
517	Electronic Decision Maker	Jan 73	30	
518	Light Beam Alarm	Apr 73	59	TP2
519	Nickel Cadmium Battery Charger	Feb 74	65	TP3
520	Digital Stopwatch	Oct 73	96	TP2
521	Digital Clock	July 73	52	TP2
521	Digital Clock (seconds display)	Apr 75	77	
521B	Digital Alarm Clock	Mar 74	62	
524	Low Cost Laser	Dec 73	42	TP2
525	Drill Speed Controller	Oct 74	62	SP1, SP2
526	Printimer	Aug 74	64	
527	Touch Control Light Dimmer	Nov 74	71	
528	Home Burglar Alarm	Jan 75	67	TP3
529	Electronic Poker Machine	May 75	58	
		June 75	50	

ETI TEN-YEAR PROJECT INDEX

				Also In
530	Temperature Controller, Zero Cross On/Off	Oct 74	80	
530B	Temperature Controller, Zero Cross Proportional	Oct 74	80	
530C	Temperature Controller, Phase Controller	Oct 74	80	
531	Coin Collector	Dec 74	44	
532	Photo Timer	June 75	41	
533	Digital Display	July 75	54	
533	Digital Display — Updated Version	Aug 76	68	TP3, TG1
534	Calculator Stopwatch	Jan 76	47	
535	Swimming Pool Alarm	Nov 75	42	SP1, TP4
536	Low Price Digital Clock	Jan 75	72	
537	Low Battery Warning	Feb 75	61	
538	Hornet Calculator Power Supply	Mar 75	79	
539	Touch Switch	Mar 76	39	SP2
540	Universal Timer	May 76	38	TP4, TG1
541	Train Controller	June 76	51	TP4, SP2
543	STD Timer	July 76	48	
544	Heart Rate Monitor	Sept 76	74	
546	GSR Monitor	Mar 77	46	TP4, TP5, TP7
547	Telephone Bell Extender	June 77	41	SP2
548	Photographic Strobe	May 77	46	SP2, TP5
549	Induction Balance Metal Detector	May 77	37	SP2, TP5
550	Digital Dial	Aug 78	66	
551	Light Chaser	Sept 78	47	
552	LED Pendant	Sept 78	33	
553	Tape/Slide Synchroniser	Oct 78	59	
555	Light Activated Tacho	Nov 78	70	
556	Wind Speed and Direction Indicator	Dec 78	66	
557	Reaction Tester	Feb 79	61	
558	Masthead Strobe	Feb 79	37	TP7
559	Cable Tester	Mar 79	59	
560	Mains Cable Seeker	May 80	47	
561	Metal Detector	Mar 80	31	TP7
562	Geiger Counter	Apr 80	29	TP7
563	Fast NiCad Charger	July 80	33	
564	Digital Clock	Aug 80	27	TP7
565	Helium-Neon Laser	July 80	25	TP7
566	Pipe and Cable Locator	Apr 80	36	
568	Sound or Light Operated Flash Trigger	Oct 80	21	
572	Digital pH Meter	Dec 80	23	TP7
573	Universal Process Timer	Oct 79	55	
574	Disco Strobe	Sept 79	43	TP6
575	Portable Fluorescent Light Wand	Aug 79	55	
576	Electromyogram	Sept 79	35	
576	Electromyogram Part 2	Oct 79	62	TP6
577	General Purpose Power Supply	Oct 79	49	TP6
578	Simple NiCad Battery Charger	June 80	59	
581	Dual Power Supply	June 77	36	TP5, 30AP
582	House Alarm	July 77	51	TP5
	House Alarm — installing	Aug 77	83	TP5
583	Marine Gas Alarm	Aug 77	30	TP5
585	Ultrasonic Switch	Sept 77	83	TP5, TP6
586	Shutter Speed Timer	Oct 77	45	TP5
587	UFO Detector	May 78	18	
588	Theatrical Lighting Controller	Nov 77	75	TP6
	" " "	Dec 77	67	TP6
	" " "	Jan 78	31	TP6
	" " "	Mar 78	47	TP6
589	Digital Temperature Meter	Dec 77	50	TP5, TG2
590	LCD Stopwatch	Oct 78	74	TG2
591	Up/Down Presettable Counter	July 78	56	TG2
592	Light Show Controller	Aug 78	51	
593	Colour Sequencer	Dec 78	89	
594	Development Timer	Apr 79	39	
595	Aquarium Light Controller	May 79	52	
597	Emergency Lighting Unit	Dec 80	57	
598	Sequential Touch Switch	Feb 81	44	
1500	Discriminating Metal Detector	Dec 80	39	TP7

ELECTRONIC MUSIC

403	Guitar Sound Unit	Apr 71	24	25TP, SP1, AP
408	Spring Reverberation Unit	Mar 72	60	25TP
414	Master Mixer	Feb 73	50	AP, 30AP
	" "	Mar 73	58	AP, 30AP
414	Master Mixer	Apr 73	78	AP, 30AP
	" "	May 73	59	AP, 30AP
414a	Master Mixer Modification	Aug 73	104	AP, 30AP
424	Spring Reverb Unit	Sept 74	58	SP1, AP
428	Colour Organ	Nov 74	77	TP3
430	Microphone Line Amplifier	Mar 75	66	
601	International Music Synthesiser 4600	Oct 73	24	Complete
		Nov 73	74	synthesiser
		Dec 73	75	is published
		Jan 74	50	in book form
		Feb 74	58	(3600 & 4600)
		Mar 74	76	
		Apr 74	66	
		June 74	66	
		July 74	69	
	International Music Synthesiser 3600	Mar 75	41	
		Apr 75	74	
		May 75	62	
		Aug 75	51	
602	Mini Organ	Aug 76	51	TP4
603	Sequencer	Aug 77	77	
604	Accentuated Beat Metronome	Sept 77	39	SP2, TP5
605	Temp. Stabilised Log-Exponential Converter	Sept 78	54	
606	Electronic Tuning Fork	Nov 79	38	TP6

COMPUTER PROJECTS

630	Hex Display	Dec 76	56	
631	ASCII Keyboard	Dec 76	47	
631	Keyboard Encoder	Apr 77	55	C&C
632	Video Display Unit	Jan 77	95	
632	" " " Part 2	Feb 77	69	
632	" " " Part 3	Mar 77	81	
633	TV Sync Generator	Jan 77	65	
634	8080 Educational/Prototyping Interface	July 78	105	
634	" " Part 2	Aug 78	80	
635	Microcomputer Power Supply	Sept 77	66	C&C
636	S100 Motherboard	May 80	52	C&C
637	Cuts Cassette Interface	Jan 78	25	C&C
638	EPROM Programmer	July 78	85	C&C
639	Computerised Musical Doorbell	Mar 78	58	
640	S100 VDU	Apr 78	32	C&C
	" Part 2	May 78	89	C&C
	" Part 3	June 78	57	C&C
641	S100 Printer	Sept 78	89	C&C
642	16K S100 RAM card	Feb 79	53	
643	Universal EPROM Programmer	Dec 79	69	
643	EPROM Programmer Software	Jan 80	82	C&C
650	STAC Timer	Nov 78	51	
651	Binary-to-Hex Number Converter	June 79	79	C&C
680	An S100 CPU Using the Z80	Nov 79	30	C&C
681	Programmable Character Generator for S100 System	June 80	67	
682	S100 PROM Board	Mar 81	99	

RADIO FREQUENCY

701	TV Masthead Amplifier	Dec 74	50	SP1
702	Radar Intruder Alarm	May 75	37	TP3
703	Antenna Matching Unit	June 75	80	
704	Crosshatch/Dot Generator	Aug 75	35	TP3, TG1
705	Three Simple Receivers	Dec 75	38	SP1, SP2
	a) Biased Diode Crystal Receiver			
	b) Voltage Multiplier Crystal Receiver			
	c) Solar Powered Radio			
706	Marker Generator	Feb 76	53	TG1
707	Modern Solid State Converters:			
	a) 28 MHz Band	Feb 76	66	
	b) 52 MHz Band	Feb 76	64	
	c) 144 MHz Band	Feb 76	68	
708	Active Antenna	Mar 76	47	TP4, SP2
709	RF Attenuator	Mar 76	59	

				Also In
710	Booster Amp for Two Metre Band	Apr 76	86	
711	Remote Control Transmitter	July 76	62	TP6
711	Remote Control Receiver	Aug 76	48	TP6
	" " "	Sept 76	59	TP6
	" " "	Oct 76	69	TP6
712	CB Power Supply	June 77	56	TP5
713	Add-on FM Tuner	Sept 77	31	
714	VHF Log-Periodic Antenna	Feb 78	45	
		Mar 78	33	
715	VHF Power Amplifiers	Nov 77	29	
716	VHF Power Amplifiers	Jan 78	51	
717	Crosshatch Generator	May 78	69	TG2
718	SW Radio	Oct 78	42	TP6
719	Field Strength/Power Indicator	Nov 78	64	TG2
720	2m VMOS Power Amp	Jan 79	71	
721	Aircraft Band Converter	Mar 79	39	TP6
722	Antenna for Aircraft Band Converter	May 79	60	
724	Microwave Oven Leak Detector	July 79	67	TG2, TP7
725	Simple SSB Generator (polyphase)	Aug 79	48	
726	70W Booster Amp for 6 & 10m	Feb 80	65	
727	Antenna Matcher	Jan 81	47	
728	UHF TV Antenna	Mar 81	41	
730	Get Going On Radioteletype	Aug 79	40	
---	Versatile Antenna Tuner Covering 1.5 MHz to 7 MHz	Sept 79	57	
730/1	Improvements to the RTTY System	Mar 80	54	
731	Get Going on Radioteletype — Part 2	Sept 79	50	
740	FM Tuner	Feb 76	28	TP3
	FM Tuner (construction details)	Mar 76	27	TP3
780	Novice Transmitter	May 76	52	
		June 76	71	

ELECTRONIC GAMES AND PUZZLES

801	LINC	May 75	54	
802	Electronic Windicator	Feb 75	60	SP1
803	Cannibals and Missionaries	Dec 75	100	SP1
804	Selectagame	Nov 76	44	TP4
804	Selectagame (rifle project)	Mar 77	54	TP4, SP2
805	Puzzle of the Drunken Sailor	Oct 77	82	SP2
806	Skeet	Jan 78	45	TP5
810	Stunt Cycle TV Game	June 78	31	
811	TV Tank Game	Oct 78	66	
812	Wheel of Fortune	Dec 78	73	
813	Race Track Game	Jan 79	79	
814	The Dinky-Die	Aug 79	30	

PROJECT BOOKS	Code	Cover price
25 Top Projects	25TP	NLA*
Top Projects 2	TP2	NLA
Top Projects 3	TP3	NLA
Top Projects 4	TP4	NLA
Top Projects 5	TP5	$3.00
Top Projects 6	TP6	$3.95
Top Projects 7	TP7	$3.95
Audio Projects	AP	NLA
30 Audio Projects	30AP	$3.95
Simple Projects 1	SP1	NLA
Simple Projects 2	SP2	$2.95
Test Gear 1	TG1	$3.00
Test Gear 2	TG2	$3.95
Project Electronics (4th edition)	PE	$4.75
Computers & Computing — 1980 Yearbook	C&C	$4.95
International 3600 & 4600 Synthesisers		$12.50
Other books		
Circuits 2		$2.95
Electronics it's Easy 1		$3.00
" " " 2		$3.00
" " " 3		$3.00
Transducers in Measurement and Control		$9.00

*No Longer Available

"DREGS"

THE HACKS who write for DREGS suffer as much from inflation as the rest of you, but we have hit upon what we think is a unique way to hedge against it. Casual reading of the financial press has convinced us that these days the smart money is going not into precious metals whose prices tend to fluctuate, but into antiques and other collectors' items which increase in value at a steady rate, often outstripping inflation by a good margin.

It's the 'other items' that interest us. Some things that were as common as dirt only twenty-five years ago, like Dinky Toys or souvenir mugs for Queen Elizabeth II's coronation, are now quite valuable because at the time few people bothered to hang on to them. DREGS predicts that in a few years' time the same will be true of electronic components. Once a few people begin to collect something, a kind of positive feedback effect operates to increase their value: any increase in value makes more people interested in buying, and the more people are interested in buying the more the value increases. All it needs is a little stimulus to start the process off.

So we're currently combing through our junkboxes and delving in the darkest recesses of old-established component shops in search of undiscovered treasures. Of course the items of outstanding historical interest, like first series de Forest triodes, are no doubt extremely scarce and only found these days in museums, but other items, like vacuum photodiodes and early integrated circuits, should be fairly easy to come by, because at the moment few people realise their potential value. In general anything that is obsolete and despised today is likely to be worth money in the future. So hang on to those paper capacitors and dedicated games chips — one day they'll be worth a packet.

And remember, you read about it first in DREGS.

Sydney journalists view Toshiba's prototype pocket LCD TV receiver.

THE GREAT DREGS Awful Puns Competition gets worse and worse.

Brian Eyre of Devenport, Tasmania, sent in the following shaggy dog story (abbreviated in order to fit it in one issue of the magazine); unfortunately he can't win the prize because it doesn't really fall into any of our categories of electronics, audio or communications puns, but we thought we'd print it anyway and give you all a good groan.

A man's Datsun car needed repairing, and the mechanic said it needed a new cog, costing \$56. As the man was about to visit Japan anyway, he said he would buy the cog there, no doubt much cheaper, and bring it back with him.

At the Datsun factory he found that a new cog cost only \$3.70, and immediately purchased \$50 000 worth of these Datsun cogs, visions of vast profits back home floating before his eyes.

He had to charter an old plane to ferry all the cogs back, but because of air traffic control was forced to fly over part of China. During this detour the old plane developed engine trouble, and the pilot insisted that the load must be dumped to enable a safe landing. Sorrowfully the man opened the door and started throwing his cogs out.

Way down below, a Chinese man and his wife were hoeing their crop. When the car parts started to fall down around them he called out to her: "Watch out, dear, it's raining Dat-sun-cogs."

But this month's prize goes to Ian Boehm of Coburg, Vic, whose horrible joke produced the most groans all round the office and so qualifies as the winner. He reports: "Recently I attended the Electronics Ball — a dreary affair. The only interesting event was seeing that charming pair Mr and Mrs A.C. Voltage back together again. They spent the whole evening together dancing peak to peak."

Ian also sent in another terrible pun, but after due consideration of the obscenity laws we decided to acknowledge it rather than print it. Van aerials indeed!

Keep them coming!

UNTIL WE DEVELOPED THE STEREO GROOVE, HI-FI WAS PRETTY HO-HUM!

The world of hi-fi owes a lot to the original and continuing innovation of JVC. Few companies, if any, have done as much to help turn records and record-players into the virtual musical instruments they are today . . . or to lead the way in developing so many *firsts* in the more recent concepts of sound amplifiers, cassette decks and computer-designed speaker systems. Hi-fi, as we know it today, had its beginnings in 1956, with JVC's development of the 45°/45° groove for stereo records. The fact that this system still remains as the world standard is, in itself, outstanding testimony to the technology of JVC. The development revolutionised not only the record-*making* industry, in which we've been involved since 1930; it also paved the way for enormous advancement in the design and engineering of record-playing equipment. Now, hi-fi has expanded to

R-S77. Super-A FM/AM Stereo receiver

embrace a wealth of highly-sophisticated electronic equipment; and it's not surprising that JVC has continued to play a leading role in so much of its development.

HR-3660 EA. VHS Colour Video Cassette recorder

THAT WASN'T OUR ONLY FIRST, EITHER.

We also pioneered Japan's television industry, introducing their first TV receiver just over 40 years ago. A more recent innovation is VHS, the home video recording system now gaining world-wide acceptance as *the* system for such equipment. In the course of staying ahead, we've introduced a number of world *firsts* of radical importance: the Quartz Lock turntable is one of them.

THE QUARTZ LOCK TURNTABLE. MANY TIMES MORE ACCURATE.

It stands to reason that if your equipment is at the top end of the range, then your turntable must be capable of comparable performance. Only Quartz Lock ensures this, tying the speed of the turntable to the unvarying pulse of the atom, and providing a level of accuracy far in excess of conventional turntables.

MORE MILESTONES IN HI-FI.

To match the superb quality of Quartz Lock, we produced the S.E.A. graphic equalizer system. Then we refined it to such a degree it even compensates for the effect your furniture has on sound when it leaves the speakers! To expand the capabilities of tape, we designed ANRS and

SEA-80. Stereo Graphic Equalizer

Super ANRS — automatic noise reduction systems which not only reduce distortion and 'hiss' but actually extend the dynamic range of the tape. Similarly, with speakers: at JVC we employ computers in their design to help provide the ultimate in sound reproduction.

AND NOW, SUPER-A.

In its own way, as significant a hi-fi development as the stereo groove. Imagine an amplifier which combines the *best* features of the two recognised amplifier classes (A and B) . . . an amp which combines the *efficiency* of one with the *low distortion* of the other. Some engineers said it couldn't be done; but not those at JVC. Enter the Super-A amplifier . . . the *latest* JVC *first!*

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JVC
the right choice

THE FUTURE.

It's already with us. For instance, we were so far ahead in the new metal tape technology that our cassette decks were metal-compatible before the tapes were generally available. And now there's the JVC Electro-Dynamic Servo Tonearm, damping tonearm resonance by means of a purely electronic system and two 'thinking' linear motors. Who was it who dubbed JVC, 'the innovators'?

1861

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